INDONESIAN AGRICULTURAL PRODUCTIVITY AND ITS RELATION TO DEVELOPMENT STRATEGY: A VALUE-ADDED APPROACH

BY

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While productivity growth is essential to raise per capita income, its trends and sources of change in Indonesian agriculture have not been adequately understood. This study was directed toward measuring agricultural productivity growth rates. Growth rates were then related to the adopted development strategies. The concept of value added as a restricted profit function was applied in measuring the productivity growth rates and in estimating the elasticities of output, the derived demand for intermediate inputs, the shadow prices for primary inputs, and technical change biases.

In the period 1950-78, agricultural value added rose at an annual rate of 2.82 percent while the income share of primary inputs grew at 2.22 percent a year. The average growth rate of productivity was, therefore, 0.60 percent

annually. This rate varied among the periods characterized by different policy strategies. During the postwar reconstruction period (1950-58), productivity growth was 0.45 percent, it dropped dramatically to -1.99 percent during the guided economy period (1959-66), and then rose to 1.57 percent in the years of the new order (1967-78).

Partial productivity of land grew at 2.39 percent annually during postwar reconstruction, 0.90 percent during the guided economy period, and 2.30 percent in the new order period. Similar growth patterns were indicated by productivity of labor--that is, the rate fell from 2.82 to 1.05, then rose to 2.85 percent. The growth rate of capital productivity changed more dramatically--0.59, -1.32, and 3.40 percent for the three periods, respectively. For the period 1950-78, the productivity growth rates of land, labor, and capital were 1.81, 1.93, and 0.96 percent, respectively.

Elasticity of value added on normalized price of intermediate inputs was -0.03. An increase of 1 percent in land, labor, and fixed capital could be expected to raise the value added as much as 0.40, 2.04, and 0.18 percent, respectively. Price elasticity of demand for current inputs, based on 1967-78 data, was -4.9. The shadow price functions prove the existence of complementarity between fixed capital and land area, and substitutability between fixed capital and labor force. Bias coefficients indicate the technical change has been capital saving, labor neutral, and slightly land augmenting.

CHAPTER I

INTRODUCTION

Resource Characteristics of the Country

As the largest archipelago nation in the world, Indonesia consists of more than 13,000 islands. Around 1,000 of them are inhabited. Total land area, which accounts for less than one-third of the national territory, is estimated to be 1.92 million square kilometers. Kalimantan, Sumatra, Irian Jaya, Sulawesi, and Java together make up almost 92 percent of the total land area (Table 1). The next five largest islands--Timor, Halmahera, Sumbawa, Ceram and Lombok--raise this figure to about 95 percent.

This archipelago is very strategically located between the Indian and Pacific Oceans and between the Asian and Australian continents. It stretches 5,100 kilometers, from 95° to 141° east longitude, in west-east direction and 1,888 kilometers, from 6° north to 11° south latitude, in the north-south direction (Fig. 1).

Geographically, Indonesia is formed by parts of all major structural units of Southeast Asia and the Southwest Pacific (Fryer, 1979:326). Kalimantan, the Strait of Makassar, Sumatra and Java are part of the Sunda shelf. Around the southern margin of this structural unit lies the

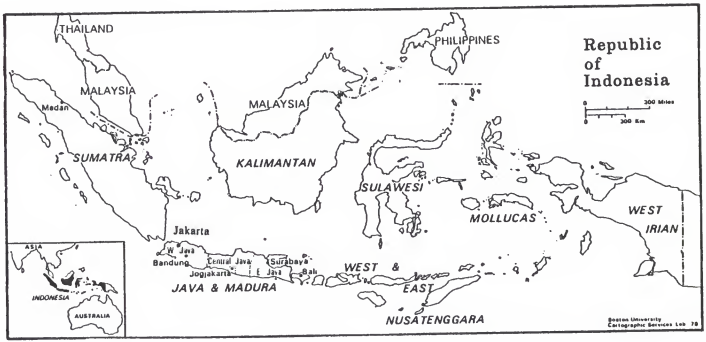
TABLE 1

LAND AREAS OF INDONESIA BY ISLAND OR GROUP OF ISLANDS

Island, or group of islands	Size	Percentage of the total land area
	km^2	percent
Java and Madura	132,187	6.89
Sumatra	473,606	24.67
Kalimantan	539,460	28.11
Sulawesi	189,216	9.85
Irian Jaya	421,981	21.99
Others[a]	162,993	8.49
TOTAL	1,919,443	100.00

Source: Statistical Pocketbook of Indonesia, 1979/80.

[a]Includes East Timor which has 14,874 km^2.



Source: Adapted from Papanek (1980:xxii).

Fig. 1. Indonesia: Location and Size.

circum-Sunda mountain system, which runs through Sumatra, Java, and Nusatenggara. The eastern part of the archipelago is the Sahul shelf, which includes the Irian and Aru islands. And, on the northern margin of the Sahul shelf, the mountains in Irian and the Solomon Islands are part of the circum-Australia system. The peculiar physical geography of this country is the product of its complex geological structure (Fryer and Jackson, 1977:7).

Mount Kinibalu, the highest peak in Southeast Asia (4,100 meters), is on the great island of Kalimantan. However, elevations higher than 1,500 meters are limited, and most of the island lies below 200 meters. Indeed, there are very large alluvial swamps along its coasts. The swampy lands account for 18.7 million hectares with 3.7 million hectares potentially usable for agriculture (Collier, 1979:3).

Sumatra is comprised of three major divisions which are parallel to its long axes. A high but narrow complex mountain system, the Bukit Barisan, which broadens into an extensive highland mass lies in the western part of the island. There is little coastal plain in this area, except Aceh, and all of the rivers flowing to the Indian Ocean are short. A submountain hill country extends eastward from the mountains and gives way to extensive alluvial lowlands and tidal swamp areas along the southeastern coast. Around 1.8 million hectares of the 17.9 million hectares of swampy land have potential for crop production.

Java has strong relief elements that are fragmented into blocks, and separated by broad plains with fertile soils. The southern portion of this land, however, has a series of plateaus with thin and poor soil. North of these southern mountains lies a volcanic belt which broadens in West Java into an upland mass. In Central and East Java, the volcanoes form conical masses which are separated by a broad fertile plain. This type of structure continues further eastward to the western islands of Nusatenggara.

Sulawesi lacks extensive plains and is considerably more mountainous than Java. Active volcanoes are also less numerous. Nusatenggara (except Bali) and Maluku are groups of non-volcanic islands that have a limited resource base. Irian Jaya has virtually no active volcanoes to offset the impoverishment of the soil of its humid tropical climate. It contains inaccessible mountains and large wild swamps.

Various parts of the country show significant climatic differences, particularly in terms of the amount and distribution of rainfall. Most areas receive a heavy, and generally well distributed, rainfall, but from Central Java eastward a dry season becomes more and more visible. The northern coasts of Sumba and Timor generally receive less than 25 millimeters of rain from July to October, while West Java receives 200 to 400 millimeters in the same period. In addition, many islands show striking differences in the amount and distribution of rainfall between their northern and southern coasts, or between eastern and western coasts.

The natural vegetation of a great portion of Indonesia is tropical forests. However, due to repeated cutting and burning for the so-called shifting-field cultivation in large areas, the forests have been replaced by grasslands of alang-alang (Imperata sp.). The process has been accelerated by commercial forest exploitation which has intensified since the early 1970's. The magnitude of forest loss in Indonesia is enormous; so great that Fryer (1979:332) has estimated that the loss in this country may account for as much as half of forest removals within the humid tropics. Public funds have been allocated for reforestation of the alang-alang areas, but this effort seems to have had very little success.

The fertile cropland areas in Java, Bali, and East Sumatra and the large swamp areas in Kalimantan, Sumatra, and Irian Jaya are major land resource endowments for agriculture. Forests, mostly in Kalimantan and Irian, produce timber and other forest products which have contributed significantly to the total domestic product. Around 2 percent of the gross domestic product (GDP) came from this subsector in 1972-77. Since more than two-thirds of the national territory is covered by water, marine and island fisheries are important economic activities. Valuable fishes, pearls, and other marine products also made up around 2 percent of the GDP in this period.

Aside from the large potential land area and marine products, Indonesia is rich with mineral endowments. East

of the Persian Gulf, it is the main oil producer. In 1979, for instance, 580.4 million barrels of crude oil and 998.5 million cubic feet of natural gas were produced. Export of these accounted for 65 percent of total foreign earnings. Other important minerals are bauxite, nickel, copper, tin, and coal. In 1979, the country produced 1,057 thousand tons of bauxite, 1,552 thousand tons of nickel, 189 thousand tons of copper, 29 thousand tons of tin, and 279 thousand tons of coal. Mining and quarrying contributed 10.5 percent to the GDP.

With a population of more than 141 million in 1978, Indonesia is the fifth most populous country in the world. The rate of growth of the population in the period 1950-70 was 2.1 percent, and in 1970-78 it was 2.3 percent a year. Sixty percent of the people still depend on agricultural activites for a living. There were 74 people per square kilometer in the country as a whole in 1978 (Table 2)--7 people per hectare of agricultural land.

A striking characteristic of Indonesian demography is the highly unequal geographic distribution of population. People are crowded in certain regions, while other parts of the country are sparsely populated. Sixty-three percent of the population lives on Java (including Madura) which has less than 7 percent of the total land area of the country. The population density of this region in 1978 was 645 people per square kilometer. The population pressure on land and resources in this region is a serious problem in

TABLE 2

POPULATION AND DENSITY OF POPULATION BY ISLAND OR GROUP OF ISLANDS IN INDONESIA, 1978

Island, or group of islands	Population	Density of population
	million	no./km^2
Java and Madura	88.19	667
Sumatra	26.17	55
Kalimantan	6.41	12
Sulawesi	10.16	54
Nusatenggara[a]	7.74	105
Maluku	1.32	18
Irian Jaya	1.12	3
Indonesia	141.11	74

Source: Data from Statistical Pocketbook of Indonesia, 1979/80, adjusted to Indonesian population series.

[a]Excludes East Timor which had approximately 0.5 million people in an area of 14,874 square kilometers.

development. While 60 percent of the people are in agriculture, one-third of all farmers are landless. For those who have land, the average farm size is half a hectare.

There have been continuing efforts to alleviate the unequal distribution of the population. Transmigration has been used since the Dutch colonial period. However, the effort has had a negligible effect. In seven years, from 1971-72 to 1977-78, only 294,226 persons transmigrated--64,450 of them spontaneously migrated. A large number of the participants in the government-sponsored transmigration returned to Java, or moved to provincial or district cities. To some extent this apparent failure was due to inadequate planning, but more than anything else the effort to develop the outer islands by creating more economic opportunities and better living conditions, which are essentials for transmigration, seems to have been inadequate. The opportunity to have a better standard of living is the main reason people move. Without an economic incentive, the poor people in Java will not move to the outer islands.

Economic Structure

During the period 1967-71, there was a very high rate of investment--26.12 percent annually (Table 3). Private consumption grew at a rate smaller than output, exports grew faster than imports, and the inflation rate fell. Later periods showed a slowing down in the investment rate and the growth of imports exceeded that of exports.

TABLE 3

RATES OF GROWTH OF GROSS DOMESTIC PRODUCT BY EXPENDITURE CATEGORIES, 1967-1971, 1971-1975, AND 1975-1979

	Period		
	1967-71[a]	1971-75[b]	1975-79[b]
	percent per year		
Private consumption	5.56	9.17	6.82
Public consumption	10.31	12.68	9.12
Gross investment	26.12	17.48	10.53
Export	13.47	9.20	11.16
Import	12.23	26.70	12.76
Gross domestic product	8.07	8.31	6.82

Source: Basic data from Statistical Pocketbook of Indonesia, various issues, and U.N. National Account Statistics, 1977.

[a]Based on constant 1960 prices.

[b]Based on constant 1973 prices.

Structural changes accompanied the growing economy and the share of different sectors changed sharply. in 1967 agriculture contributed 54 percent of total output measured at current market prices. By 1979, the share had dropped to less than 45 percent (Table 4). On the other hand, the contribution of mining and quarrying increased more than five times from 1967 to 1979. Another striking increase occurred in construction--from 1.7 percent in 1967 to 6.0 percent in 1979. Manufacturing, trade, and public administration showed a moderate yet steady increase in the shares in total output.

The leading growth sectors--oil production, construction, and timber production--are capital intensive and dependent on high technology. These are not labor intensive and, as predicted by Djojohadikusumo (1975:22), will remain so during the greater part of the 1980's until backward linkages of industrial activities are sufficiently generated.

During most of the early and mid-1960's, the value of spending declined due to rapid inflation and low tax collections. Moreover, part of the government spending was financed by deficits in the balance of payments. These deficits stopped in 1967 due to petroleum exports, and revenues as well as expenditures have since risen. Real total spending rose sharply in the last decade and in 1978-79 it was more than five times that of 1968. Development spending rose faster than routine expenditures. The share for development budgeted by government rose from 30 percent

TABLE 4

SECTORAL-OUTPUT SHARES OF GROSS DOMESTIC PRODUCT IN INDONESIA, SELECTED YEARS

Sector	Current prices			Constant prices			
	1967	1971	1979	1967[a]	1971[a]	1971[b]	1979[b]
	percent of GDP						
Agriculture	53.9	43.6	29.8	51.8	45.9	44.0	32.2
food crops	(35.5)	(25.4)	(17.5)	(32.8)	(29.7)	(26.1)	(18.7)
commercial crops	(7.6)	(8.2)	(5.7)	(10.2)	(8.3)	(7.5)	(6.4)
livestocks	(3.9)	(3.3)	(1.8)	(5.0)	(3.8)	(3.4)	(1.7)
fishery	(6.2)	(3.0)	(1.8)	(2.7)	(2.1)	(3.6)	(1.7)
forestry	(0.7)	(3.7)	(3.1)	(1.1)	(2.0)	(3.4)	(3.7)
Mining & quarrying	2.7	6.5	16.9	3.7	5.6	9.9	10.5
Manufacturing	7.3	9.4	9.2	8.4	9.4	8.8	12.9
Construction	1.7	3.4	6.0	1.6	3.0	3.0	5.7
Trade	17.6	18.8	18.3	15.8	17.7	16.7	16.4
Public administration	4.8	5.6	7.1	5.5	5.2	5.9	8.0
Services and others	12.0	12.7	12.7	13.2	13.2	11.7	14.3
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Statistical Pocketbook of Indonesia, various issues, except the figures in the second column from right hand side which are from U.N. Yearbook of National Account Statistics, 1977.

[a]Based on constant 1960 prices.

[b]Based on constant 1973 prices.

of total expenditures in 1968 to over 50 percent in 1978-79 (Dapice, 1980:20-21).

Exports have been growing rapidly since 1970. This has been the major force that has helped the economy grow in the 1970's. Most of the growth in exports is attributable to oil, timber, and minerals. Oil and gas exports jumped from $239.6 million in 1967 to $8,870.9 million in 1979, and tin from $53.1 million to $381.9 million (Table 5). Timber exports rose from $6.3 million in 1967 to $995 million in 1978 and dropped slightly to $796.7 million in 1979. On the other hand, export of copra has declined from $13.6 million in 1967 to a negligible amount in 1978.

Total imports rose nearly twelve-fold, from $649.2 million in 1967 to more than $7,203 million in 1979 (Table 6). There have been shifts in the share of total value of commody groups imported. Imports of capital goods increased sharply from 1967 to 1976, and declined slightly thereafter. Imports of raw materials showed a relatively steady increase up to the year 1979, while imports of consumption goods showed a declining trend.

Despite the sharp increase in imports, export growth and capital inflow have resulted in an improvement in Indonesia's reserve position. The balance of payment deficits of the 1960's have been overcome in the 1970's. Table 7 shows that the trade balance in 1967 was $16 million. The balance increased to $130.8 million in 1971 and to

TABLE 5

VALUE OF INDONESIAN EXPORTS BY COMMODITY, 1967, 1971, AND 1975-1979

Commodity	Year						
	1967	1971	1975	1976	1977	1978	1979
	US $ 1,000,000						
Oil & gas	239.6	447.9	5,310.8	6,004.1	7,297.8	7,438.5	8,870.9
Tin	53.1	51.9	56.0	117.0	229.6	281.6	381.9
Timber	6.3	161.4	500.0	781.8	951.2	995.2	796.7
Rubber	168.3	221.9	358.2	530.8	558.3	716.5	939.8
Coffee	43.8	55.3	99.8	237.5	599.3	491.3	614.5
Palm oil	23.6	44.7	151.6	135.5	183.6	208.8	204.4
Tea	9.6	28.9	51.5	56.6	118.5	94.7	83.4
Tobacco	14.7	15.2	35.2	38.6	55.0	55.4	56.5
Copra	13.6	12.4	3.3	0.3	0.0	-	-
Others[a]	92.8	194.0	536.1	644.3	829.4	1,361.2	3,642.0
Total	665.4	1,233.6	7,102.5	8,546.5	10,852.7	11,643.2	15,590.1

Source: The 1967 and 1971 figures are from Indikator Ekonomi, June 1976, and the rest are from Statistical Pocketbook of Indonesia, 1979/80.

[a]Includes palm kernels, pepper, copra cake, rattan, fiber, copal, and damar.

TABLE 6

IMPORTS OF INDONESIA BY SELECTED CATEGORIES, 1967, 1971, AND 1975-1979

Year	Consumption goods	Raw materials and auxiliary goods		Capital goods	Total
		including petroleum products	excluding petroleum products		
		US $ 1,000,000			
1967	232.5	237.7	225.6	179.0	649.2
1971	210.2	428.0	407.6	464.6	1,102.8
1975	677.5	1,961.1	1,707.6	2,131.2	4,769.8
1976	915.9	2,024.1	1,586.4	2,733.1	5,673.1
1977	1,104.6	2,452.5	1,720.5	2,673.2	6,230.3
1978	1,196.6	2,664.5	2,084.8	2,829.3	6,690.4
1979	1,182.2	3,328.2	2,534.9	2,691.9	7,202.3
		Percent of total imports			
1967	35.8	36.6	34.8	27.6	100.0
1971	19.1	38.8	37.0	42.1	100.0
1975	14.2	41.1	35.8	44.7	100.0
1976	16.1	35.7	28.0	48.2	100.0
1977	17.7	39.4	27.6	42.9	100.0
1978	17.9	39.8	31.2	42.3	100.0
1979	16.4	46.2	35.2	37.4	100.0

Source: Statistical Pocketbook of Indonesia, 1979/80.

TABLE 7

IMPORTS, EXPORTS AND TRADE BALANCES INCLUDING AND EXCLUDING PETROLEUM PRODUCTS IN INDONESIA, 1967, 1971, AND 1975-1979

Year	Including petroleum products			Excluding petroleum products		
	Exports	Imports	Balance	Exports	Imports	Balance
			US $ 1,000,000			
1967	665.4	649.2	16.0	425.8	636.6	-210.8
1971	1,233.6	1,102.8	130.8	755.7	1,082.4	-326.7
1975	7,102.5	4,769.8	2,332.7	1,791.7	4,516.3	-2,724.6
1976	8,546.5	5,673.1	2,873.4	2,542.4	5,235.4	-2,693.0
1977	10,852.6	6,230.3	4,622.3	3,554.8	5,498.3	-1,943.5
1978	11,643.2	6,690.4	4,952.8	4,204.7	6,110.7	-1,906.0
1979	15,590.1	7,202.3	8,387.8	6,719.2	6,409.0	310.2

Source: Statistical Pocketbook of Indonesia, 1979/80.

$8,387.8 million in 1979. Without petroleum exports, the balance would have been negative in most of these years.

Pertamina (a state-owned oil company) had a crisis in the first three quarters of 1975 which led to a sharp fall in reserves. By the last quarter of 1975, the crisis had ended and reserves had returned to the 1974 level. Oil reserves rose to almost $2.5 billion by the end of 1978 (Dapice, 1980:38), and continued to grow to $7.2 billion in 1980. Much of the growth was due to an increase in the base price of Indonesian oil (Pauker, 1981:232).

Problem Setting and Objectives

Two important growth phenomena related to agriculture have occurred in the decade of the 1970's. First, the rate of growth of gross value added in this sector was relatively low as compared to that of GDP as a whole. From 1971 to 1979, agricultural value added grew at an annual rate of 3.8 percent while the GDP rose almost twice as fast at an annual rate of 7.5 percent (Table 8). The second interesting point is that the year to year growth in value added in agriculture fluctuated widely from 0.0 to 9.3 percent in the eight-year period, compared to a fluctuation of 4.9 to 11.3 percent for the GDP.

The slower growth in agriculture, as compared to that of the total economy, resulted in increased imports of agricultural products. Despite the fact that rice is the main farm commodity in this agrarian country, Indonesia has

TABLE 8

AVERAGE ANNUAL GROWTH RATES OF GROSS DOMESTIC PRODUCT BY MAJOR SECTORS OF INDONESIA'S ECONOMY, 1972-1979

Sector	Year								Average 1971-79	Projected REPELITA[a] III
	1972	1973	1974	1975	1976	1977	1978	1979		
	percent									
Agriculture	1.6	9.3	3.7	0.0	4.7	1.6	7.2	2.2	3.8	3.5
Mining and quarrying	22.3	23.3	3.4	3.6	15.0	12.4	-2.8	0.3	9.7	4.0
Manufacturing	15.1	15.2	16.2	12.3	9.7	8.6	14.8	9.2	12.6	11.0
Construction	29.8	18.0	22.1	14.0	5.4	18.7	8.1	6.4	15.3	9.0
Transport and communication	9.0	12.2	12.1	5.1	13.2	17.8	11.6	13.8	11.8	10.0
Others	12.9	7.6	9.4	10.7	5.1	8.8	7.6	5.9	8.5	8.1
Gross domestic product	9.4	11.3	7.6	5.0	6.9	7.4	7.2	4.9	7.5	6.5

Source: Suhartono (1980:6) updated with 1979 data from Statistical Pocketbook of Indonesia, 1979/80.

[2]REPELITA III is the third Five Year Development Plan.

for years been the biggest buyer of this grain in the world market. The imports of rice peaked in the late 1970's; between 1976 and 1979, the country imported more than 7.02 million tons, an average of more than 1.75 million tons a year with an average value of $0.58 billion. In addition to rice, Indonesia has been a net importer of sugar and cloves for many years, and copra and soybeans in the past few years. Meat, particularly beef, has long been imported to supply hotel and restaurant needs.

Total agricultural production increased by 3.0 percent a year during the period 1971-79. Food crop production rose at a rate of 2.7 percent annually. During the last half of the period, 1975-79, there was a smaller growth rate for food (2.1 percent) and a higher rate for total agriculture (3.2 percent). Among the food crops, only rice, peanuts, and corn showed a rate of increase above the population growth rate. Cassava production grew at a rate of half the population rate, while sweet potatoes and soybeans showed negative growth rates. These trends do not hold much promise of self-sufficiency in the basic food stuffs.

In March 1978, the Majelis Permusyawaratan Rakyat (MPR, People's Consultative Assembly) formulated the Third REPELITA (Five-Year Development Plan) for 1979-1984 as well as a long-run plan for national development. The need to satisfy the domestic demand for basic commodities, food as well as non-food consumption goods, through increased domestic production was emphasized. An equitable distribution

of income was a goal in the Third REPELITA and was to be achieved through agricultural development to increase the income of farmers since farmers as a group had below average incomes.

Land to increase agricultural production is available in Kalimantan, Sumatra, Sulawesi, and Irian where the man/land ratio is low. Land reclamation on these islands could, therefore, play a considerable role in pursuing the goal of basic food production. Java, Madura, and Bali, on the other hand, have a very high man/land ratio so that expansion of agricultural land is virtually impossible.

In all regions the level of productivity per unit of land as well as per unit of labor remains low. Hence the prospects for increasing yields and output per worker seem to be promising. Increasing productivity is expected to be a chief means of raising per capita output and income. Other benefits that will be brought about by increasing productivity, as indicated by Kendrick (1977:1), are conservation of scarce resources (land in Java, labor in the outer islands, and capital in all regions), cheaper food which mitigates inflation, and an increase in the competitiveness of domestic production.

Trends in agricultural growth and productivity have not been adequately studied in Indonesia. The relationships between agricultural productivity and agricultural policy are not well understood. Policies to increase food production to meet the needs of the rising population need to

be as efficient as possible. Increased production of agricultural commodities for export are also needed for foreign earnings.

This study is basically aimed at analyzing the growth and productivity of agriculture and relating it to the basic development strategies in Indonesia. For this purpose the following objectives were pursued:

1. To describe agricultural growth and policies in Indonesia,
2. To measure the growth rates of agricultural productivity in various periods,
3. To estimate the effects of changes in price of input relative to output and in the amount of primary input,
4. To observe the technical change biases brought about by agricultural growth, and
5. To relate the growth rates of productivity to the changes in basic agricultural policies.

Plan of Dissertation

Chapter II is used to review the literature on the empirical measurement of productivity. In the second part of the chapter, the theoretical framework and analytical procedure applied in this study are described and defended.

The identification of the phases characterized by different basic policy strategies of Indonesia and the corresponding agricultural policies adopted to promote economic

growth and stability are covered in Chapter III. This discussion is used in later chapters in relating the policies to the agricultural growth and productivities to meet the fifth objective of this study.

Numerical results of the analyses are presented in three chapters. Chapter IV deals with the trends of input--primary and intermediate--and outputs. Chapter V contains the productivity growth estimates which can be considered as the heart of the analyses. The translog models used in the estimation and the subsequent total productivity growth rate estimates are presented in the first part. Partial productivity growth rates are presented in the next part. To further the discussion, an inter-country comparison is offered at the end of Chapter V.

The estimates of elasticities of aggregate output, the elasticities of derived demand for intermediate inputs, the shadow prices for primary inputs, and the technical change biases of agricultural growth are presented in Chapter VI.

Finally, Chapter VII gives the summary of the study, and the conclusions of the results. Some policy inplications and suggestions for future research are offered, and data limitations are identified.

CHAPTER II

CONCEPTUAL AND ANALYTICAL DESIGN

Empirical Analyses of Productivity

Literature Review

Productivity may be defined as a ratio of output to one or more inputs (Rees, 1980:1). It is a family of ratios of quantity (real value) of output to quantity (real value) of the related inputs (Siegel, 1980:23). Total productivity refers to the relationships between output of goods/services and the resource inputs (Kendrick, 1977:1). In a simultaneous-response function this may be measured as

$$\theta = \sum_{k=1} w_k y_k / \sum_{j=1} v_j z_j, \qquad (1)$$

for which y_k refers to the k^{th} output; z_j is the j^{th} input of resources, v_j and w_k are price weights to combine the various resource inputs and outputs, respectively. For time series analysis, one should use real prices of outputs and inputs. This productivity ratio is usually presented as an index number.

An increase in total factor productivity implies that the outputs as an aggregate increase faster than the factor

inputs as a aggregate. Productivity can change as the ratio of utilization of fixed inputs change--e.g., an intensification of the use of land by increasing the cropping index. In the long run the productivity will rise as technology and productive organization are improved. It can also increase due to a change in economies of scale in the industry.

A partial productivity ratio for factor j in the simultaneous response can be expressed as

$$\theta_j = \sum_{k=1} w_k y_k / v_j z_j \ . \qquad (2)$$

This ratio will be affected by a change in the use of any other factor(s), and/or a change in the efficiency of the factor itself due to an improvement in technology.

The above definition of productivity is based on the concept of average productivity of resources in question. Strand and Heady (1955) used this concept in observing total and partial productivity with respect to labor, capital investment and total resources. Their study was done by focusing on regional differentials. The principal measures used were residual returns per man equivalent worker, residual return per dollar investment, and ratio of value of total output to the value of all inputs. Fabricant (1959) applied a similar concept in observing the trends of total and partial productivity ratios for the U.S. economy. The

year to year changes in productivity were found to be largely influenced by the state of business. When business was expanding productivity increased and when business was contracting it often declined. Some fluctuation was attributed to random factors.

In addition to output, value added has been used as a basis to estimate the indexes and the growth rates of productivities. For examples, David and Barker (1979) in the Philippines, Ban (1979) in Korea, and Lee and Chen (1979) in Taiwan used value added as well as output to analyze the growth patterns of agriculture. The growth paths were in turn related to the resource characteristics, domestic policies, and international market situations.

Production function models using cross-sectional data have been applied to get estimated input weights for estimating a productivity ratio. The choice of variable is generally limited by the availability of data. Griliches (1963:335) regressed the value of output on livestock expenses, interest on value of land, depreciation and interest of buildings, machinery expenses, other current expenses, average full time equivalent number of workers per commercial farm and average education of the rural population. Research for technological progress, extension and training were mentioned as important factors in productivity growth but the data for regional comparison were not available. Hertford (1971) applied a similar procedure to explain the rapid expansion in output of Mexican agriculture

which occurred during 1940-1965. He regressed composite output on non-capital purchased inputs, hired labor, family labor, land, livestock capital and power and implements. Both of these studies were based on the fitting of a Cobb-Douglas type function. The estimated parameters were used to obtain the values of input shares which are required in the estimation of a total productivity ratio.

In analyzing the causes of productivity growth, most studies have been based on the estimation of aggregate production function models. Up to the 1960's, according to Griliches (1963:331), the functions used were generally of the form $Y_t = Y(X_t, u_t, T_t)$ where Y_t represents physical output in an industry, X_t is vector of inputs, u_t is a random variable due in part to weather in agriculture, and T_t is the level of technology, a postulated unobserved latent variable usually to be observed from data as a residual. Studies using this formulaton led to the conclusion that a large portion of the growth was explained by the residual factor which is not very helpful in understanding growth. The stability of a function, if it is to be useful, should be emphasized. To label the unexplained residual changes in output as technical changes and to measure them, he argued, are not meaningful in the analysis of productivity growth. The output change should be attributed to changes in the quantity and quality of inputs and to economies of scale. Residual measure of productivity growth should be viewed as

errors such as those due to misspecification of the production function, and measurement errors in observing variables.

Kendrick (1973:134-138) regressed the rate of growth of productivity on nine variables, i.e., growth rate of output, rate of change in real capital, variability of output changes, average education per employee, ratio of research and development expenditure to sales, average hours of work, degree of concentration of each industry, rate of change in concentration and degree of unionization. These variables allow for the effects of cyclical variability of output, the stock of human capital, technological advances and market powers of the firms and unions. A later study which included 15 variables was done by Kendrick and Grossman (1980) on the trends and cycles of productivity in the U.S. economy. The variables used were capacity utilization rate, cyclical variation in the use of capital, stock of human capital, private research expenditures, work hours, concentration ratio, unionization, mandays idled due to work stoppage, population abatement expenditures, composition of the work force by sex, composition of the work force by production versus salaried workers, composition by age, lay-off rates, quit rates and the shift of employment in industries. Aside from the coefficents of the multiple regression model, simple correlation coefficients between the rate of change in productivity and the above explanatory variables across the manufacturing industries were also

estimated. The estimated parameters were used to analyze the effects of the 15 variables on productivity growth.

Toward an Alternative Approach

Indexes and growth rates of productivities have been measured by applying the concept of average productivity of inputs in question, either based on output or on value added. A production function approach has also been used to estimate input weights necessary in aggregation. This approach is quite demanding in terms of data. Due to gaps in data series, researchers have had to interpolate and make other rough estimates of data points, e.g. see David and Barker (1979), Lee and Chen (1979) and Ban (1979).

Value added series are a part of national income accounts. Aggregate output and especially aggregate inputs are not commonly reported. The concept of value added in a restricted profit function, proposed by Bruno (1978), provides an alternative for measuring and analyzing growth and productivity. Aside from the lesser data requirements, this concept has other desirable properties which will be discussed in the following section.

Theoretical Framework

Duality Approach in Production Analysis

In applied research, the profit function has become increasingly popular. Every concave production function has

a dual which is a profit function convex in input prices and vice versa. The existence of one-to-one correspondence between the set of concave production functions and the set of convex profit functions has been shown by McFadden (1978: 81-93). One can, therefore, consider only the profit function for production analysis.

Derivation of the profit function (Lau and Yotopoulos, 1972:11-12) starts with a production function possessing neoclassical properties

$$y = y(X, Z) \tag{3}$$

where: y is output; X represents an m-vector of variable inputs and Z represents an n-vector of fixed inputs. Profit then can be defined as

$$P = py(X, Z) - r'X \tag{4}$$

where: P is profit; p is unit price of the output and r represents an m-vector of prices of the variable inputs.

Assuming fixed prices, the first order condition of profit maximization is

$$p \frac{\partial y(X^*, Z)}{\partial X} = r \tag{5}$$

or, by defining R = r/p as an m-vector of normalized input prices, we can write

$$\frac{\partial y(X^*, Z)}{\partial X} = R \tag{6}$$

Similarly, one can rewrite (4) in terms of unit output price profit, UOP profit

$$\Pi = P/p = y(X, Z) - R'X. \tag{7}$$

If the sufficient conditions hold,[1] the optimal quantity of inputs can be solved and expressed as a function of the normalized prices of variable inputs and qualities of fixed inputs, i.e.

$$X^* = X^*(R, Z) \tag{8}$$

Inserting (8) into (7) gives the indirect UOP profit function written as

$$\Pi^* = y^*(R, Z) - R'X^*(R, Z) \tag{9}$$

This is an envelope function that represents the maximized value of profit for each set of values of R and Z (Silberberg, 1978:168).

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[1]These conditions are that production is carried on in the economically rational area. If so for a given R, the Hessian of Π^* with respect to Z will be negative definite, and for a given Z the Hessian with respect to R will be positive definite. Lau (1978) proved these results.

To connect the profit function and the production function McFadden (1978:74-76) and Lau (1978:197-214) derived a set of dual transformations. By taking partial derivative of the indirect UOP profit function with respect to normalized prices, one can obtain the derived demand for inputs, i.e.,

$$X^* = - \frac{\partial \Pi^*(R, Z)}{\partial R} \tag{10}$$

And, by inserting (10) into (9) and solving for y^* the output supply function will be obtained which is given by

$$y^* = \Pi^*(R, Z) - (\frac{\partial \Pi^*(R, Z)}{\partial R})'R \tag{11}$$

Lau and Yotopoulos (1972:12) emphasized three advantages of using the UOP profit function. Firstly, factor demand and output supply functions can be derived directly from a UOP profit function without an explicit specification of the corresponding production function. Secondly, the resulting system of supply and factor-demand functions is assured to be from profit maximization under competitive conditions with a production function concave in the variable inputs. And, lastly, the profit, supply and factor-demand functions may be explicitly written as functions of variables determined independently of the firm's behavior so that simultaneity in the estimation is less of a problem.

Value Added as a Restricted Profit Function

To enlarge the usefulness of duality theory of production in empirical works, Bruno (1978:3-14) developed the concept of value added as a restricted profit function, and showed its application in measuring productivity change. Nominal value added (NVA) is simply defined as gross returns minus total costs of imtermediate inputs. The NVA function varies as output or input prices do. Hence, a modification is needed for the purpose of measuring an economic change. One of the modifications is value added based on a single output price deflation (SVA), denoted as G. Corresponding to (9) one can write the indirect SVA function

$$G = Y^{*}(R, Z) - R'X^{*}(R, Z) \tag{12}$$

where: Y is a composite of gross output; X is an m by 1 vector of imtermediate inputs; R represents an m by 1 vector of normalized prices of the elements of X and Z represents an n by 1 vector of basic inputs. And corresponding to (11),

$$Y = G(R, Z) - G_{R}(R, Z)'R \tag{13}$$

a supply function based on the value added concept.

The dual derivative property holds simultaneously on this function, i.e.,

$$G_{R} = -X^{*}; \tag{14a}$$

$$G_Z = Y_Z = W^* \tag{14b}$$

where W^* is the derivative of G with respect to primary inputs which gives the shadow prices of the inputs, while the derivative with respect to the normalized prices of intermediate inputs gives the optimal input bundle. The Hessian of G with respect to factor Z is negative definite, and with respect to normalized prices R, it is positive definite

$$G_{ZZ} = Y_{ZZ} = Y_{ZX}(\frac{\partial X}{\partial Z}); \quad G_{RR} = -Y_{XX}^{-1} \tag{15}$$

and the mixed derivative,

$$G_{RZ} = \frac{\partial X^*}{\partial Z} = -Y_{XX}^{-1}Y_{XZ} \tag{16}$$

which gives the total response of X with respect to a change in Z allowing adjustment in Y.

Another modification of NVA is the double deflated value added (DVA), defined as $F = Y^* - X^{*\prime}e$, where e denotes a vector of 1's. Prices in the base period are normalized to be all equal to one, and the real value added is measured in the base-year output and input prices. The existence of this real value added and its use for aggregate data analyses, as concluded by Diewert (1978:40-41), are justifiable as long as the prices of commodities within group vary in

strict proportion. And, using (12) and (14), the function can be expressed as

$$F = G + G'_R(e - R). \tag{17}$$

The effect of changes in the normalized price of intermediate inputs on DVA can be obtained by taking the first derivation of F with respect to R

$$F_R = G_R - G_R + G_{RR}(e - R) = -Y_{XX}^{-1}(e - R) \tag{18}$$

And, similarly, the effect of changes in basic resources on DVA can be obtained as

$$\begin{aligned} F_Z &= G_Z + G_{RZ}(e - R) = Y_Z + Y'_{XZ}Y_{XX}^{-1}(e - R) \\ &= Y_Z - Y'_{XZ}F_R \end{aligned} \tag{19}$$

The residual deflation procedure which is also called the double deflation method is generally regarded as conceptually appropriate (David, 1962:149). Equation (19), however, shows the possible biases associated with the substitution of DVA for the true gross output. Although the condition of relative marginal-primary-factor productivities holds (i.e., $Y_Z > 0$), one can not guarantee that $F_Z > 0$, except if we assume $R \geq e$, implying $Y'_{XZ}F_R \geq 0$, then $F_Z \geq Y_Z \geq 0$. Fortunately, linear homogeneity could hold

since $Z'F_Z = F$ whenever $Z'G_Z = G$. For any pair of primary factor ℓ, $k \in Z$, based on (19) one can write

$$\frac{F_\ell}{F_k} = \frac{Y_\ell(1 - (Y_{\ell X}/Y_\ell)F_R)}{Y_k(1 - (Y_{kX}/Y_k)F_R)} \tag{20}$$

And, the condition that DVA will lead to a derived value-added production function whose partial derivative will correctly measure the marginal productivities of the primary factor, $F_\ell/F_k = Y_\ell/Y_k$, can be expressed as

$$[\ Y_{kX}/Y_k - Y_{\ell X}/Y_\ell\ ]\ F_R = 0 \tag{21}$$

This will be satisfied if either constant relative prices ($R = e$, hence, $F_R = 0$), constant intermediate factor proportion ($Y_{XX}^{-1} \to 0$ which results also in $F_R = 0$) or Y is functionally separable in X and Z which implies that $\frac{\partial}{\partial X}(\ln (Y_\ell/Y_k)) = 0$ and $(Y_{kX}/Y_k) = (Y_{\ell X}/Y_\ell)$.

SVA function as shown by (14) is free from the above possible bias. However, DVA has practical application in measuring real total factor productivity. It is also useful in the analysis of the effect of tariff structure and tariff change on resource allocation (Bruno, 1978:10).

In order to derive a measure of productivity, let us suppose that the underlying gross output function takes the form $Y = Y(X, Z, T)$, where T is a scalar for technical

progress shift factors. The corresponding SVA function is $G = G(R, Z, T)$. It can be shown (Bruno, 1978:11) that $G_T = Y_T$ implying that the actual estimate of technical progress can be represented by either the first derivative of SVA or gross output with respect to the scalar T. But, the observed estimate from this SVA function ignores variation in the normalized prices of intermediate inputs. The estimate could be derived by total differentiation of G(R, Z, T) and given by

$$\frac{dG}{dT} - G'_Z \frac{dZ}{dT} = Y_T + G'_R \frac{dR}{dT}$$

And, multiplication of both sides by dT/G results

$$\frac{dG}{G} - \frac{G'_Z}{G} dZ = \left(\frac{Y}{G}\right)\left(\frac{Y_T}{Y}\right)dT + \frac{G'_R}{G} dR \qquad (22)$$

The second term on the right hand side of this equation will generally not be zero, implying that SVA will be biased when used in measuring productivity change.

Now, let us consider the corresponding derived DVA-function, $F(R, Z, T) = G(R, Z, T) + (e' - R')G_R$. The first derivative of F with respect to scalar T gives

$$F_T = G_T + (e' - R')G_{RT} = G_T + (e' - R')Y_{XX}^{-1}Y_{XT}$$

$$= G_T - F'_R Y_{XT} \qquad (23)$$

And, by taking the total differential of F and dividing all terms by F, we have

$$\frac{dF}{F} = \frac{F'_Z}{F} dZ + \frac{F'_R}{F} dR + \frac{F_T}{F} dT \qquad (24)$$

which is the rate of change in DVA.

The total productivity change (Bruno, 1978:12) in terms of the original function Y corrected for output scale is given by

$$\phi = (\frac{Y}{F})(\frac{Y_T}{Y})dT = \frac{Y_T}{F} dT \qquad (25)$$

While the observed rate of change using observations on changes in DVA (dF/F), factor input changes (dZ) and competitive income shares per unit of input (G_Z/G) is given by

$$\hat{\phi} = \frac{dF}{F} - \frac{G'_Z}{G} dZ \qquad (26)$$

The relationship between $\hat{\phi}$ and ϕ can be derived by totally differentiating F with respect to T, multiplying the result by (1/F)dT and applying (24) and (25), to give

$$\hat{\phi} = \phi + \frac{F'_R}{F} (dR - Y_{XT}dT - Y_{XZ}dZ + \frac{G'_Z}{G} G_R Y_{XX}dZ) \qquad (27)$$

There are three alternative conditions for $\hat{\gamma}_{\phi}$ to be unbiased estimates of ϕ. First, a divisia index[2] is used to obtain DVA so that R = e and, hence, $F_R = 0$. In the case of functional separability, Sims (1969:470) has shown that double deflation procedure will yield a simple divisia index for value added. The second is that each intermediate input left out is used in fixed proportion, so that $Y_{XX}^{-1} \to 0$ which also gives $F_R = 0$. The third is constant relative prices implying R = e and $F_R = 0$.

The partial productivity of the j^{th} factor, on an output basis, has been defined by equation (2) and the rate of growth is $(d\theta_j/dT)/\theta_j$. On a value-added basis, the growth rate is measured by

$$\hat{\gamma}_{\phi_j} = \frac{Z}{F} \frac{d}{dT}\left(\frac{F}{Z_j}\right) \tag{28}$$

Measuring Technical Change Bias

Positive productivity growth indicates the occurrance of technical progress in production. This progress, following Hicks' definition, is said to be neutral if all marginal products change in the same proportion, hence the

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[2]Divisia index is defined in discrete points in time as an index of the form (Hulton, 1973:1019)

$$\log(X_t/X_{t-1}) = \sum_{i=1} \bar{v}_i \log(X_{i,t}/X_{i,t-1})$$

where

$$\bar{v}_i = \frac{1}{2}\{p_{i,t}X_{i,t} / \sum_{j=1} p_{j,t}X_{j,t} + p_{i,t-1}X_{i,t-1} / \sum_{j=1} p_{j,t-1}X_{j,t-1}\}$$

marginal rate of substitution remains constant. In a two-factor model, the technological change is j^{th} augmenting if the rate of change of j^{th} marginal product is greater than that of the other. Using a cost function, Binswanger (1974: 964) modified Hicks' definition for multiple factors, and measured the coefficient as $(d\alpha_j^*/dT)(1/\alpha_j)$ where α_j is factor share for the j^{th} factor and the asterisk indicates that the relative factor price was held constant. Applying the value added concept, a technical change coefficient can be defined as

$$A_j = \left(\frac{d}{dT}\left(\frac{F_{z_j}}{F}z_j\right)\right)\frac{G}{G_{z_j}z_j}$$

$$= \left[\frac{z_j}{F}\left(\frac{dF_{z_j}}{dT}\right) + F_{z_j}\frac{d}{dT}\left(\frac{z_j}{F}\right)\right]\frac{G}{G_{z_j}z_j} . \qquad (29)$$

And, technical change can be defined as j^{th} augmenting if A_j is positive, neutral if A_j is zero, and j^{th} saving if A_j is negative.

Analytical Procedure

Specification of the Model

As explained in the theoretical framework above, there are several desirable properties of the dual structure. This study will make use of the concept of value added which could be considered as a restricted profit function. The

model will take the form of G = G(R, Z) and F = F(R, Z) following (12) and (17).

Land, labor and capital are basic resources whose service are combined to produce value added in agriculture. Irrigation facilities, livestock capital, tractor and fishing boats are major components of productive capital. In LDC's these primary resources comprise a large portion of farm costs. The 1960 Census of Mexican agriculture, for instance, showed that the input share of land, labor and livestock capital were 29.1, 37.9 and 19.0 percent, respectively. Non-capital purchased inputs--fertilizers, farm chemicals, seeds, water and livestock vaccine--were 7.1 percent of farm costs (Hertford, 1971:17). The input share in Indonesian agriculture could be expected to be close to these figures since there are some similarities in the type of farming and the level of technology. Despite the small share, the non-capital purchased inputs have made very significant contributions to the increase in productivity. Most of the new farm methods to raise production, as emphasized by Mosher (1966:89), require the use of these inputs. Fertilizers, farm chemicals, seeds, and animal feeds will be considered as the major intermediate inputs in this study.

A double-log type specification of an aggregate neoclassical production function, as shown by Leontief (1947), implies stringent separability restrictions. And, to disaggregate factor indexes can not be meaningfully pursued

using multifactor analogs of the conventional two-factor functional forms. Multifactor Cobb-Douglas and CES functions assume strong separability. On the other hand, quadratic form does not satisfy the restriction that output increases monotonically with all inputs and that isoquants are convex (Berndt and Christensen, 1973:85).

Two functional forms which impose no separability restriction a priori and which provide approximations to any arbitrary function have been developed. The first is the generalized Leontief production function which is a quadratic form in an arbitrary number of inputs and has been proposed by Diewert (1971). And the other is the transcendental logarithmic (translog) production function proposed by Christensen et al. (1973). The translog form had both linear and quadratic terms with an arbitrary number of inputs. At least in specific regions in input space the monotonically increasing output and the convex isoquant conditions are satisfied by this functional form (Berndt and Christensen, 1973:85). For these properties, the translog function was used in this study.

Description of the Analyses

Policies regarding food prices, export inducement, credit system, supply of technical inputs and research and the characteristics of input utilizations were discussed. Performances of agricultural growth were observed by commodity involving major food crops, export crops and

livestock. The trend of production for each commodity was estimated with regression.

Aggregate agricultural production is composed of value added and competitive share of the primary inputs. Regression was applied to DVA in order to estimate its average annual change (dF) which was used to estimate the relative change in DVA (dF/F). The competitive income share was estimated with a translog model of SVA on primary inputs and normalized price of intermediate inputs. And, then the annual rate of productivity change was estimated using (26) as the yearly change in DVA minus a multiplication of competitive income share and factor input change.

Estimation of productivity growth was also undertaken by periods to relate the growth rates to the changes in basic development strategies. Fitting the translog model to these subperiods was not possible with ordinary regression techniques because of an under size sample problem. To overcome this problem, the maximum-entropy (ME) procedure was applied. The ME-moment matrix is always positive definite (Theil, 1981:1).

The concept of ME is based on the idea that something about the distribution function of random variable is known, and that it is rational to estimate it by fitting the least-informative distribution subject to the constraint of what is known. The uninformativeness is measured by the entropy of the distribution which, for continuous variable, is defined as

$$H = -\int_{-\infty}^{\infty} f(x) \log f(x)\, dx \tag{30}$$

where f(x) is the density function of the distribution (Theil, 1981:3-4).

Subject to the imposed mass-preserving and mean-preserving constraints, the density function that maximizes the entropy defined by equation (30) is sought. The most prominent features of the solution are (i) the ME distribution is uniform in each closed interval and exponential in the two open-ended intervals; (ii) the interval means of the ME distribution are the secondary midpoints, i.e., midpoints between successive primary midpoints; (iii) the ME variance equals

$$E(X-\bar{x})^2 = \frac{1}{n}\sum_{k=1}^{n} (\bar{x}_k - \bar{x})^2 - \frac{1}{4n}\sum_{i=1}^{n-1} (x^{i+1} - x^i)^2$$

$$- \frac{1}{24n}\sum_{i=2}^{n-1} (x^{i+1} - x^{i-1})^2 \tag{31}$$

and (iv) the ME covariance equals

$$E[(X - \bar{x})(Y - \bar{y})] = \frac{1}{n}\sum_{k=1}^{M} (\bar{x}_k - \bar{x})(\bar{y}_k - \bar{y}) \tag{32}$$

where X and Y are any two random variables; x^i is the i-th sample value in the form of order statistics; $\bar{x}_k$ and $\bar{y}_k$ are the k-th secondary midpoints after rearranged into original

order; and $\bar{x}$ and $\bar{y}$ are the means of the respective secondary midpoints which are also the overall means (Theil, 1981: 6-17).

The effect of changes in normalized prices of intermediate inputs on DVA was estimated by taking the partial derivative of F with respect to R and applying the parameters of the special model. Similar procedures were used in estimating the response of DVA to the changes in primary inputs. These effects were measured by using the concept of elasticity.

The derived demand function for intermediate inputs was estimated by using equation (14a). This function is a relationship between the quantity demanded of intermediate inputs and an index of their prices, index of output prices, and the amounts of primary inputs. The partial derivative of G with respect to a primary input provided an estimate of the shadow price of that input (equation 14b).

Technical change biases were observed by using equation (29). Regression coefficients from the SVA translog functional model were applied to estimate G_Z, while the coefficients from the DVA function were used to estimate F_Z and dF_Z/dT. And by using the series of Z_j's and F, the $d(Z_j/F)dT$ were estimated. G/Z and F/Z were evaluated at the means of the variables.

CHAPTER III

DEVELOPMENT STRATEGIES AND AGRICULTURAL POLICY

This chapter deals with the identification of phases of economic development strategies in Indonesia since independence. Characteristics of the policies in each strategy are discussed which later on will be applied in explaining the effect of changing basic policy on the growth rate of agricultural productivity. This chapter also concerns the food supply and export-crop production policies.

Basic Development Strategies

August 17, 1945, was marked by the proclamation of independence and the birth of the Republic of Indonesia. However, a war soon broke out as the Dutch army came back in an attempt to reinstall the pre-war colonial government. This independent war ended on December 27, 1949, when the sovereignity of the country was fully recognized.

Based on the development strategies adopted, the postwar economy of Indonesia can be broken down into three major parts--the period of postwar reconstruction, the period of the guided economy and the period of the new order. Each of these strategies has some very typical

characteristics resulted from public sentiments, the economic situation, and the political climate of the time.

The first phase began in 1950 and continued through 1958. This strategy was characterized by political independence, substantial reliance on private enterprises, tolerance of foreign investment and management, foreign exchange controls, and price regulations during the latter part of the period. At the end of this period, the take over of Dutch enterprises, which was aroused by the conflict over the return of Irian Jaya to Indonesia, was an exception to the tolerancy to foreign investment. However, private and foreign enterprises from other nationalities continued to operate. The guided economy, which was announced in late 1958 and extended through the first quarter of 1966, was characterized by an emphasis on national control and ownership, a heavy government influence in the market, an emphasis on equality, and very rigid controls on foreign exchange. The new order which began during the second quarter of 1966 has been characterized by an emphasis on economic rehabilitation and growth, a reliance on private enterprises, some role for foreign investment, and a high degree of freedom in the foreign exchange sector.

Postwar Reconstruction Period

To coordinate the administration and management of economic development, the Financial and Economic Council was established on February 28, 1950. Every minister was

required to consult with the Council regarding any action that would affect the national economy. Following the return of the nation from a federation of states to a unitary state on August 17, 1950, the Economic Urgency Program (August 1950 to August 1951) was formulated. The National Planning Board was established in 1952 but a development plan was not completed before 1956. The plan was named the Five Year Development Plan in accordance with its coverage, 1956-60. Approval from the Parliament was not obtained until 1959 because of the conflicts among political parties and a nation-wide campaign for Irian Jaya.

Right after the end of this war of independence, it was declared that the economic policy would be directed primarily to an increase in food production and the establishment of various new industries. However, many political and social conflicts made the programs very difficult to put into effect. Due to the lack of foreign exchange, no program was carried out to establish new industries. Priority was given to reconstructing industries, increasing yields on rice farms in order to reduce rice imports, and the restoration of export production (Zahri, 1969:77-78).

The infant Republic inherited a persistent budget deficit--1.55 billion guilder in 1948 and 1.31 billion guilder in 1949. This in turn resulted in an inflationary tendency. Exchange control which was started when World War II broke out was continued because of the sizeable inflation and the decline in foreign exchange reserves (Mangkusuwondo,

1974:2-4). As inflation continued, this policy led to a situation in which the government was compelled to devaluate the currency.

The Economic Urgency Program continued to give promotion to economic development. It was aimed at changing the structure of Indonesia's economy through diversifying industrial and agricultural production. Actions were taken to balance the economic capacity of Indonesian and foreign enterpreneurs. Industrialization was emphasized to achieve a balance among sectors of the economy in order to reduce dependence on foreign trade and to create employment opportunities. Small-scale industries and cottage industries were promoted through the establishment of central production and purchasing units, loans and credit, and industrial research and training. The Five Year Plan of postwar reconstruction emphasized the efforts to achieve an increase in per capita income. An annual rate of increase of 1.3 percent was the target set for the plan and an expenditure of Rp.30 billion for capital formation was planned. A better demographic distribution of development was promoted in an effort to achieve a more even population distribution (Zahri, 1969:91).

The first agricultural plan, the Kasimo Plan, was drafted in 1947 and promulgated in 1952. This plan concentrated on increased acreage, improved farming methods, better seeds, fertilizers, irrigation facilities, and implements (Higgins, 1957:55). In the Five Year Plan some

emphasis on agricultural training was added. One of the highest priorities was the establishment of agricultural schools--other priorities were improved seed selection, an increased fertilizer supply, additional mechanization, and improved farming organization and rubber replantation. Animal husbandry and fisheries were given attention. Increased irrigation was heavily emphasized and accounted for about 8.8 percent of the total central-government investment budget (Zahri, 1969:92).

Period of the Guided Economy

Political competition damaged the comprehensive objectives of the Economic Urgency Program. The Five Year Plan which was supposed to become effective in 1956 was not approved until 1959. This delay led the President and other leaders to believe that a western style democracy was not appropriate for Indonesia. In 1957 the President formed an extra parliamentary cabinet. This action, combined with the lack of decentralization of political and economic functions resulted in the proclamation of PRRI (Revolutionary Government of Indonesia) in Sumatra and Sulawesi in 1958. And, in late 1958, the President announced the so called guided democracy and guided economy.

One of the main features of the guided economy was the shift of balance from private ownership to state control. The year 1959 was marked by a drastic disappearance of government support and encouragement to indigenous private

enterprises. Import monopolies of essential commodities were turned over to the state enterprises. Also, control was extended to the marketing system in the rural areas by giving distribution rights to rural cooperatives. The establishment of government retail outlets--clothing and food stores--followed. A producing unit in agriculture, P.N. Pertani (State owned farm enterprises) was established in 1962.

The Eight Year Overall Development Plan, 1961-1968, was based on the guided economy principles. One of the highest priorities was the effort toward self sufficiency in food stuffs. A target of a 4.4 percent increase in rice production and an increase in per capita consumption from 100 kilograms in 1960 to 115 kilograms in 1968 was established. The promotion of agricultural export production seemed to be left entirely to individual exporters and producers. In the manufacturing sector, priority was placed on the production of clothing and textiles. A target was set for achieving per capita clothing production and consumption of 15 meters by the end of 1968 (Zahri, 1969:161-8).

The budgets were not achieved because of widespread mismanagement and perhaps unrealistic budgets. The administration fell in 1966. Rice production failed to increase under the plan. Nitrogen fertilizers and coal production actually dropped and the target of textile production was far from achieved.

The most highly visible mark for the guided economy was a rapidly increasing rate of inflation due to large expenditures for political purposes beyond the capacity of the economy. The budget deficit rose from 31 percent of total expenditure in 1959 to almost 59 percent in 1965. These deficits compared to an average of 15 percent of total expenditure in the 1951-57 period (Mangkusuwondo, 1974:23). During the guided economy, national income grew at only 1.55 percent a year. The serious inflation and foreign exchange crisis were the causes of severe economic stagnation in 1963 (Palmer, 1978:22); by 1965, the economy was about to collapse.

New-Order Period

Following an attempted coup by the communist forces at dawn on October 1, 1965, a new administration assumed the power in the second quarter of 1966. To overcome the inherited disarrayed economy--hyper inflation rate, stagnating output growth, budget deficit, and drained foreign reserves--a strategy of stabilization, rehabilitation, and economic development was adopted. The first two elements were to achieve a short term objective of putting the economy in order and the third was to achieve a long-term objective of a steady economic growth (Vreeland et al., 1975:285). Several fundamental shifts were announced later that year--centralized controls were relaxed and both

foreign and domestic private investment were encouraged by favorable terms of trade.

The first development plan of the new order was called REPELITA I (Five Year Development Plan I) covering the 1969-74 period. It was directed primarily toward economic stabilization, agricultural development (particularly of food commodities), rehabilitation of infrastructure and other activities supporting the agricultural sector. High priority was also given to textile production (Iberahim, 1975:1).

Vigorous implementation of the stabilization policy succeeded in bringing down the inflation rate from 650 percent in 1966 to 120 percent in 1967, 85 percent in 1968, and then to less than 10 percent in the first year of REPELITA I. GDP grew at an annual rate of 6.52 percent during 1966-69 and 8.37 percent during the 1969-74 period. By 1974, GDP amounted to Rp.10,709 billion which, by the exchange rate of that year, was equivalent to $25.8 billion. Per capita income was approximately $200, a considerable increase from less than $100 in 1966. Exports grew rapidly, from $665.4 million in 1967 to $7,184.4 million in 1974.

The second five year plan, REPELITA II, for the period 1974-79, began the shifting of resources to improve social welfare. During this plan the number of health centers was quadrupled and more than 31,000 new schools were built (Pauker, 1981:234). Industry, mining, transportation and

communication, and building and construction were planned to grow at 13.0, 10.1, 10.0 and 9.2 percent, respectively. Growth in agriculture was planned at 4.6 percent. Realizing that the great diversity in regional conditions had made the implementation of the plans difficult, the government began to decentralize the process of planning and decision making to the regional level (Iberahim, 1975:7). In each of the provinces a planning unit was established.

REPELITA III, 1979-1984, was explicitly directed toward poverty and income disparity. Equity was added to growth and national stability as a major goal in development of the country (Pauker, 1981:234). The so called eight pathways to equity was imposed to pursue a better distribution of the fruits of development among economic groups as well as among regions.

Specific Policies in Agriculture

Three forms of agricultural organization exist side by side--small-scale subsistence farming, large estates operated by business enterprises, and a combination of subsistence and smallholder commercial farming. Subsistence production of food crops is the dominant type of farming. Rice is the most important crop and accounts for half of the value of total agricultural production (Vreeland et al., 1975:311).

Most of the commercial crops, such as rubber, tobacco, coffee and tea are grown by both plantations and smallholders. Coconut is the second most important commercial

crop and is mostly grown by smallholders. Oil palm, sugar cane, and cinchona bark are raised mainly by plantations.

Food Supply

Throughout Indonesian history, food policy has had a consumer bias. The background and objective changed from time to time but the resulting policies were not encouraging for food production. Direct intervention in the market was started by the colonial administration in the 1930's to preserve the stability of the rice price. Trade barriers, price ceilings and cheap foreign imports were the main instruments used. The policy was to serve the interests of the large plantations in order to lower production costs to keep them competitive in the world markets (Mubyarto, 1970: 140). Plantations were supported in this way because they were the main source of huge tax revenues.

After independence, the rice policy was determined by the New Republic. Although basically the same as the Dutch policy, a new policy was brought about as a result of inflation in 1950 and 1951 as stated by Timmer (1975:203). Rice was rationed to civil servants and to the military to protect them from being hurt by the price hikes. The Yayasan Bahan Makanan (Foundation for Food) was established in 1950, and one of its missions was to smooth prices between lean and harvest months. Two years later, in 1952, the name was changed to Yayasan Urusan Bahan Makanan (Foundation for Food Affairs) and a mission of distributing the commodity was

added. Since domestic production was not enough to result in a low free market price, a large portion of foreign earnings had to be spent on rice imports in 1952 to meet commitments. Rice price was stable until 1954. Yields were down in 1956 and massive imports took place to keep the price down.

The rising inflation in 1958 and 1959 led the government to reinstate physical rations for all civil servants, the army, and the police and their dependants. A kind of rice allowance was added to the basic salary of government civil servants. A price ceiling was imposed for traders to keep prices low to the urban consumers.

In 1959, the so called Three Year Plan of Rice Production was launched which attempted to attain the goal of self sufficiency in this food staple. This plan had three programs: (1) improvement on rice cultivation through the use of "padi centers," (2) mechanical cultivation of dry land with rice, and (3) reclamation and cultivation of tidal-swamp lands (Affif and Timmer, 1971:137-38). However, only the first program was carried out in that year; the others were implemented in the early 1960's to support a government target of an increase from 93 kilograms to 100 kilograms of rice per capita per year within the period 1960-62.

Each padi center was to coordinate intensification on about 1,000 hectares, and about 1.5 million hectares were projected for 1964. This program was undertaken by way of credit in the form of fertilizer, seed, some cash money, and

by the instruction of farmers in the application of recommended techniques. Repayment for the credit was to be made with dry stalk. The mechanized farm programs on dry land and farm cultivation on tidal swamp were done by a government owned enterprise. The programs of the Three Year Plan were not successful, average annual imports in the period 1960-64 were much higher than in the previous periods, 1950-59 (Table 9). The failures had three major implications. Firstly, the strong centralized program which gave low prices for paddy as in-kind repayment were quite unpopular with farmers. Secondly, easy credit arrangements were abused by officials and by the farmers. And lastly, the program was hurriedly and poorly planned--partly because of an insufficient supply of competent technicians (Affif and Timmer, 1971:138).

There were very high price diffentials among regions as well as between seasons--particularly in the 1960's. Rice marketing imperfection did not reflect needed differentials to meet storage and transportation costs. Furthermore, administrators of surplus regions prohibited rice from going out because they feared the central government would not be able to help them during periods of shortages. These trade barriers accompanied by rice mills operating only for the government were faults with the policy. There was no mechanism to prevent the rice price from falling in surplus areas. Consumer prices fluctuated widely and production was discouraged by low farm prices and by inflation.

TABLE 9

AVERAGE ANNUAL IMPORTS OF RICE IN INDONESIA
BY FIVE-YEAR PERIODS FROM 1950-1979

Period	Annual import[a]	
	Total	Per capita
	1000 tons	kilograms
1950-54	441.3	5.5
1955-59	547.3	6.1
1960-64	1,044.3	10.5
1965-69	431.3	3.9
1970-74	1,038.7	8.4
1975-79	1,543.4	11.2

Source: Based on import data from F.A.O. Trade Yearbook, various issues, and Goldman (1974:107), and population data from Statistical Pocketbook of Indonesia, various issues.

[a]Expressed in terms of milled rice equivalents.

On the production side, a new approach to increase productivity was undertaken by a group of students and professors at the Bogor Agricultural University in 1963. Twelve students lived in a couple of villages and worked closely with the farmers on 103 hectares. Their efforts which resulted in yields of 64.5 quintals per hectare as compared to 31 quintals outside the project (Hadiwidjaja, 1970:23) encouraged the Minister of Agriculture to adopt this new approach. In 1964-65 the program was expanded by assigning 440 students from 9 colleges to work in 220 villages covering 1,100 hectares of rice farms. The government kept on expanding the program year by year, and the productivity declined. When the coverage reached 1.6 million hectares, the yield differentials had dropped to 22.4 quintals of dry stalk paddy per hectare. Several reasons may be offered for the lower performance as the program expanded. These are (1) unsuitable areas, such as rainfed farms, were brought into the programs; (2) some new areas covered were difficult to reach given the available transportation system; and (3) the credit needs under the program grew faster than the capacity of the country to offer it.

To overcome the problems of supplying fertilizers, chemicals, and credit and at the same time to continue the above program the government launched the so called Bimas Gotong Royong (BGR). Under this program, several foreign companies were contracted to provide the farmers with fertilizers, pesticides, seeds, and cash allowances. The

areas covered by all mass guidance programs reached 2.25 million hectares in 1968-69. The productivity, however, fell almost 20 percent from the previous year (Affif and Timmer, 1971:140). Some of the reasons for the failure were (1) the input package was so rigid that some farmers sold what they viewed as excess fertilizers to other farmers who applied it to more profitable crops; (2) the existing commercial institutions were bypassed which led to a deterioration of the private market structure and credit institutions; and (3) lower yielding rainfed rice farms were brought into the program.

Price policy was considered in 1969 and after several months of arguing, the government adopted a policy of setting price on the basis of a "farmers' formula." This formula related the price of rice to that of fertilizers; i.e., a kilogram of urea should cost no more than a kilogram of milled rice at the farm level.

To implement the incentive oriented policy, the "Perfected Bimas" was introduced in 1970-71 to replace BGR. This program laid emphasis on favorable prices of inputs, on subsidized credit, on aid through mobile extension teams, and on assuring a rice floor price. Private enterprises were allowed to participate in the distribution of fertilizers, aside from the government owned Pertani.

The need to have a buffer-stock scheme to increase price stability was emphasized in 1969. The President established the Bulog (Food Logistic Board) and gave it

three missions: (1) to carry out a buffer-stock operation to control the price; (2) to distribute the commody to certain groups of people; and (3) to participate in marketing activities as well as to build required facilities. The main objective of the buffer-stock operation was to support overall economic development by dampening inflation caused by rice price increases, by helping farmers earn reasonable income, and by giving farmers price incentives to adopt improved farm practices to increase production.

The goal of being self sufficient in food commodities, however, still seems far away. Imports of rice, as indicated earlier, have been increasing since the early 1970's. In the period 1975-78 total and per capita imports reached their highest levels. Around 10 percent of consumption came from imports which were sold in the domestic market at subsidized prices.

Export Commodity Production

Rubber, coffee, tea, tobacco, oil palm, cinchona bark, and kapok have been a major source of export earnings. Until the late 1960's, rubber alone accounted for roughly half of the total value of exports. Other crops added another one-fifth of the value. However, there was a lack of effort given to this subsector in the 1950's and the first half of the 1960's. The export value of rubber, copra, and tea increased in 1951 responding to the increasing international demand during the Korean War and declined

thereafter (Table 10). Only palm oil showed a good performance. Tobacco showed a decline in 1955.

Attempts to restore the production of plantations brought about political consequences. In 1953 the government chose the program which would give economic rationality the top priority through tax incentives and exchange regulations. Policies were aimed at the restoration of damaged estates to their prewar productive capacity. However, these policies were difficult to carry out, since the estates to be restored belonged to foreigners and involved removal of the squatters from the lands surrounding them. The decade of the 1950's was characterized as the years of lost opportunity in the expansion of productive capacity (Thomas and Panglaykim, 1967:7).

A large state-owned plantation enterprise, Perusahaan Negara Perkebunan (PNP) was established in 1957 to assume the operation of plantations from foreign enterprises. Efforts to restore the capability of these plantations as the main source of export earnings was unsuccessful. Declines in international market prices, a lack of effective research for production techniques, and insufficient managerial capability were the causes of the failure.

Plans to raise income from export crops were revived in the Eight Year Overall Development Plan. These plans included expansion of sugar areas and rehabilitation of old sugar factories, rejuvenation of 260 thousand hectares of native rubber and 180 thousand hectares of estate rubber,

TABLE 10

ANNUAL VALUE OF AGRICULTURAL EXPORTS FROM INDONESIA FOR SELECTED COMMODITIES, BY FIVE-YEAR PERIODS FROM 1950-1979

Period	Exported commodity					
	Rubber	Copra	Coffee	Tea	Tobacco	Palm oil
	US $ 1,000,000					
1950-54	392.62	70.40	25.12	30.20	30.76	20.66
1955-59	364.62	32.20	22.58	27.18	29.68	24.04
1960-64	292.66	23.12	17.30	21.92	22.96	21.24
1965-69	203.24	20.08	42.46	14.02	15.34	25.56
1970-74	307.70	10.44	75.46	30.04	24.91	69.72
1975-79	629.72	0.00	408.48	80.94	48.13	176.78

Source: Based on 1950-1964 exports from Thomas and Panglaykim (1967:13), 1965-1969 exports from Indikator Ekonomi, June 1976, and 1970-1979 data from Statistical Pocketbook of Indonesia, various issues.

increased tobacco areas, increased yield of existing oil palm plantations, and the rehabilitation of tea and coffee plantations abandoned during the war. Again the targets were not achieved. A decline in quality, severe competition in the export market and the development of substitutes resulted in a decline in the prices of export crops. For example, the price of rubber (RSS I) went down from more than $0.39 per pound in 1955 to less than $0.26 in 1965 and to $0.15 in the second quarter of 1967 (Hadiwidjaja, 1970: 19). Coupled with the stagnating growth of production, the price declines severely damaged the traditional sources of export earnings.

After the downfall of the guided-economy administration in 1966, the programs on export crops were revised through an intensive study of the world markets. REPELITA I included improvements in marketing facilities, the improvement of existing experiment stations, and the establishment of some regional stations.

To boost export earnings the new order administration approved foreign investments in the timber industry on the outer islands. Production and export of this commodity grew rapidly in the late 1960's. At the end of 1970, more than 100 enterprises were actively operating on about 12.6 million hectares. Most of these were on Kalimantan. By 1972 forestry accounted for about one fourth of private foreign investment outside the oil industry (Vreeland et al., 1975:328). During 1975 to 1978, the value of timber

exports exceeded that of rubber, the traditional leading agricultural export commodity. Restrictions which were imposed in 1971 to avoid a "drain" of this resource led to a decline in exports in 1979.

CHAPTER IV

INPUT AND OUTPUT TRENDS

Productive Inputs

Agricultural inputs in this study were classified into primary (basic) inputs and intermediate (current, operating) inputs. The first consists of land, labor and fixed capital, while the second category is composed of fertilizers, farm chemicals, feeds, seeds, fuels, and others. A stock concept of how much of each resource was available each year for production was used.

Primary Inputs

The trends of agricultural land, labor and fixed capital are shown in Fig. 2 for the 1950-78 period. Fixed capital has been growing faster than the other two factors. Agricultural land showed a bit faster growth than the labor force.

Table 11 presents the growth rates of the factors of production for the three development strategy periods discussed in Chapter III. The annual growth rates for land and labor were 1.02 and 0.90 percent for the entire period 1950-78--considerably smaller than the population growth rate of 2.17 percent. The lower growth of agricultural

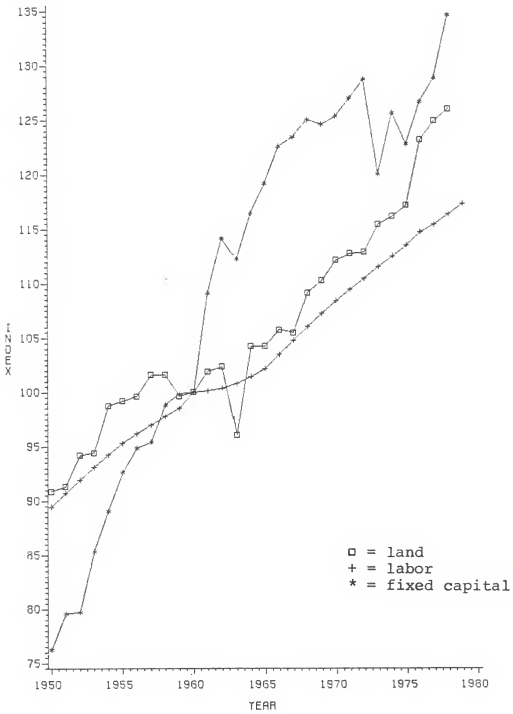

Fig. 2. Trends of land, labor, and fixed capital in Indonesian agriculture, 1950-1978.

TABLE 11

ESTIMATED RATES OF GROWTH IN LAND, LABOR, AND CAPITAL IN INDONESIAN AGRICULTURE FOR VARIOUS PERIODS

Period	Annual growth rate[a]		
	Land	Labor	Fixed capital
		percent	
1950-1958	1.54	1.11	3.34
1959-1966	0.74	0.59	2.90
1967-1978	1.59	0.94	0.39
1950-1978	1.02	0.90	1.78

[a]Estimated by regressing the logarithm of agricultural land (Table A-1), labor force (Table A-2), and fixed capital on time. Fixed capital was composed of irrigation facilities (based on Table A-3), tractors (Table A-4), fishing boats (Table A-5), and livestock capital (Table A-6), valued at 1960 prices. The coefficients of the regressions are presented in Table B-1.

labor as compared to population indicates that a structural change has been taking place in production and employment. In terms of the economy, as discussed earlier, agriculture, although growing, has been shrinking relative to the remainder of the economy as overall growth occurred. The growth rates of land and population indicate that per capita farm land has been declining. The productivity of land must be increased if Indonesia is to be self sufficient in food production.

Both land and the labor force in agriculture showed a drop in the average annual growth rate from the postwar reconstruction period to the period of the guided economy--from 1.54 to 0.74 percent and 1.11 to 0.59 percent, respectively. This drop indicates stagnation in private agricultural expansion since the state owned Mekatani had land reclamation projects--particularly in Kalimantan and in Sumatra--during the early 1960's. One may argue that the intensive campaign on land reform in the years of the guided economy became a strong disincentive for farmers and private enterpreneurs to expand farm size. And, there was no substantial absorption of the labor force by other sectors as the economy was sluggish and highly inflationary. The only sector with growing employment seemed to be in the public sector as people were needed to implement centralized controls on the economy.

The growth rate of land and labor rose again in the new order period approaching the levels in the postwar reconstruction years while the growth rate of fixed capital

dropped to less than 0.4 percent a year from 3.34 and 2.90 percent a year in the first and second period, respectively. The emphasis on increased food production and the restoration of the export-crop plantations in the early 1950's led to a higher proportion of public expenditure on irrigation projects. Irrigated area rose from 3.52 million hectares in 1950 to 4.03 million hectares in 1954 and to 4.36 in 1958 (Table A-3), an increase of 0.84 million hectares within 8 years.

During the guided economy, emphasis was placed on mechanization by state owned enterprises. The number of tractors jumped from 700 units in 1959 to 5,100 units in 1963 and to 6,500 units by the end of the period (Table A-4). Irrigated area on the other hand showed a slight decline. The irrigated area fell from 4.38 million hectares in 1959 to 3.93 in 1963 and then rose slightly to 4.18 million hectares in 1966. The area irrigated began increasing again in the late 1960's and had increased to 5.3 million hectares by 1978.

Non-powered fishing boats showed a steady increase from 1950 to the early 1970's. The number declined thereafter as they were replaced by powered boats whose number rose sharply beginning in 1972. While non-powered fishing boats declined from 286 thousand units in 1972 to 225 thousand units in 1978, the number of powered boats increased from less than 9 thousand units to more than 22 thousand units during the same period (Table A-5).

Populations of livestock generally increased steadily from 1950 to 1958 and then more sharply to 1966 (Table A-6). The figures went down thereafter until the early 1970's. The population of buffalo, a traditionally most important large farm animal, declined throughout the new order period in part because they were replaced by tractor power. The same was true for horses. On the other hand, goats, sheep, and cattle resumed their population growth since the mid 1970's.

Intermediate Inputs

Attempts to raise domestic food production through intensification have been made since the early years of the Republic. The "panca usaha" (five efforts to increase production), consisting of improved varieties, better water management, fertilization, pest/disease control, and better farm practices, have long been introduced to the farmers through extension/education activities. The government has also imported and supplied the farmers with seeds, fertilizers and farm chemicals.

Table 12 shows the ever-increased consumption of nitrogen, phosphate, and potash fertilizers. Average annual consumption of nitrogen in the first four years of REPELITA II was more than 28 times that of the early years of the Republic. Annual consumption of phosphate increased more than 26 times, while annual consumption of potash rose more than 18 times. Fertilizers applied to rice rose from

TABLE 12

AVERAGE ANNUAL CONSUMPTION OF FERTILIZERS IN INDONESIA FOR VARIOUS PERIODS

Period	Nitrogen (N)	Phosphate (P_2O_5)	Potash (K_2O)
	1,000 tons annually		
1949/50 - 1953/54	13.42	4.40	1.48
1954/55 - 1957/58	23.88	8.17	3.40
1958/59 - 1961/62	47.78	21.97	6.38
1962/63 - 1965/66	89.30	24.75	3.48
1966/67 - 1968/69	137.77	24.50	5.53
1969/70 - 1973/74	252.67	53.12	17.60
1974/75 - 1977/78	375.83	116.60	26.88

Source: Based on annual consumption of 1950/51 to 1968/69 reported by F.A.O. Production Yearbook, various issues, and 1969/70 to 1977/78 reported by U.N. Statistical Yearbook, various issues.

64 thousand nutrient tons in 1963-67 period to 167 thousand tons in 1968-72 (Herdt, Te and Barker, 1977-78:192).

To meet the domestic requirements, the country began producing nitrogen fertilizer in 1963 and by the late 1970's was self sufficient in this particular intermediate input. Some nitrogen fertilizer has even been exported to neighboring countries. However, phosphate and potassium fertilizers are still imported.

Farm chemicals for rodent, pest and disease controls have been imported. Import of these chemicals grew steadily from 1950 to the early 1960's, dropped in the mid 1960's and then resumed an upward trend in the late 1960's.

As an element of the package of panca usaha, high yielding seeds have been emphasized. The innovation of IR-5 and IR-8 by the International Rice Research Institute (IRRI) marked a new impetus in rice production. These two high yielding varieties were soon introduced and adopted by the farmers in 1967--particularly those in the Bimas programs in 1967. Several other varieties which were considered to have better quality and/or higher resistance to certain disease, such as IR-36 have followed.

It is not surprising to note that trends in the consumption of fertilizers, new seeds, and farm chemicals are very much related to trends in irrigated area. The effectiveness of these inputs, particularly for annual crops, depends on water control.

Agricultural Output

Aggregate Production

Agriculture grew at a rate of 3.99 percent annually in the postwar reconstruction period (Table 13). The rate of growth went down to 1.66 percent annually in the years of the guided economy and increased to 3.80 percent a year in the new order period. Among all agricultural commodity groups, food crops received the most attention in all periods. The rate of growth of this commodity group was 5.17 percent a year in the 1950-58 period, substantially higher than the population growth rate and that of total agriculture. In the 1967-79 period the annual growth rate was 3.51 percent, which was also higher than the population growth rate. Despite the intensified campaign of self sufficiency in food, the guided economy failed to maintain a rate of growth from falling below that of population. The annual rate was 1.27 percent as compared to a 2.09 percent population growth rate.

In the third period meat and fish production showed higher growth rates than in the previous periods. This increase resulted in part from government efforts to improve the quality of food toward higher protein. Increased growth was also experienced in forest production and to a lesser extent in export crops. The government insisted on increasing export earnings in order to finance development

TABLE 13

ESTIMATED GROWTH RATES OF AGGREGATE PRODUCTION IN INDONESIAN AGRICULTURE, VARIOUS PERIODS

Period	Annual growth rate[a]	
	Total agriculture	Food crops
	percent	
1950-1958	3.99	5.17
1959-1966	1.66	1.27
1967-1978	3.80	3.51
1950-1978	2.82	2.73

[a]Estimated by regressing the logarithm of aggregate production on time using data in Table A-7. The regression coefficients are presented in Table B-2.

projects which were needed after the near-collapse of the economy in the mid 1960's.

Production Trend by Commodity

All of the six major food crops--rice, maize, cassava, sweet potatoes, soybeans, and peanuts--rose at rates substantially higher than the population growth rate during the postwar reconstruction years. Non-rice food crops grew rapidly: sweet potatoes at 8.35 percent annually, cassava at 6.72 percent, soybeans at 6.75 percent, maize at 4.94 percent, and peanuts at 4.74 percent (Table 14). The rapid growth of harvested areas of sweet potatoes, cassava, and soybeans are shown by the data in Table A-8. These growth rates indicate a diversification in the food supply during the period.

The second period, 1959-66, was marked with downward trends in soybeans and cassava. Growth rates were -1.18 and -0.04 percent, respectively. Sweet potatoes, peanuts, and rice grew at rates of 0.10, 0.55 and 1.15 percent, respectively--considerably below the population growth rate. The national campaign for increasing food production was only able to maintain a high growth rate of maize production at 3.82 percent a year.

Striking differences were shown by the period 1967-79 in the rates of growth of food commodities as compared to immediate preceding period. In the new order years, rice and peanuts showed the highest growth rate ever. Soybeans

TABLE 14

ESTIMATED GROWTH RATES OF PRODUCTION OF SELECTED FOOD CROPS IN INDONESIA, VARIOUS PERIODS

Commodity	Annual growth rate[a]		
	1950-1958	1959-1966	1967-1979
		percent	
Rice	2.78	1.15	5.47
Maize	4.94	3.82	2.43
Cassava	6.72	-0.04	1.89
Sweet potatoes	8.35	0.10	0.52
Soybeans	6.75	-1.18	3.06
Peanuts	4.74	0.55	4.80

[a]Estimated by regressing the logarithm of production of the respective crop on time using data in Table A-9. The regression coefficients are in Table B-3.

and maize grew at about half the respective rates of the postwar reconstruction period.

Commercial crop productions depend on world markets since they are largely exported. After the 1951 Korean war boom, the price of major export crops, notably rubber, declined considerably. Table 15 presents the rates of growth of these crops for various periods. Despite the expansion in planted area of rubber from 1951 to 1957 (Table A-10) as a response to the good prices in 1951, production declined from 1953 to the mid 1950's. The growth of production was slow (0.95 percent a year) up to the mid 1960's.

Coffee showed a rapid growth of 7.76 percent per year during the period of the guided economy. This increase was due to a sharp increase in coffee prices. Oil palm maintained its growth rate at around 3 percent a year. The production of coconut, tea, and tobacco declined during this highly inflationary period.

All of these commercial crops showed upward trends in production during the period 1967-79. Oil palm production grew at a rate exceeding 11 percent a year, followed by tobacco and coconut at 4.00 and 3.61 percent, respectively. Tea also trended upward in this period, although the rate was smaller than that in the postwar reconstruction period. Coffee showed a decline in the rate of growth to 2.05 percent during this latter period.

TABLE 15

ESTIMATED GROWTH RATES OF PRODUCTION OF SELECTED COMMERCIAL CROPS IN INDONESIA, VARIOUS PERIODS

Commodity	Annual growth rate[a]		
	1950-1958	1959-1966	1967-1979
		percent	
Rubber	-2.16	0.95	1.18
Coconut	5.98	-0.36	3.61
Coffee	5.83	7.76	2.05
Tea	3.12	-0.75	1.82
Tobacco	2.11	-2.93	4.00
Oil palm	2.88	2.65	11.11

[a]Estimated by regressing the logarithm of production of the respective crops on time using Table A-11. The regression coefficients are in Table B-4.

Number of cattle slaughtered rose throughout the period 1950-59 with a slowing down in the late 1960's. Beef production grew at a rate higher than that of population growth in the first two periods, but declined in the period 1967-78 (Table 16). Non-beef meat production showed the highest growth rate in the latest period and caused a downward adjustment in number of animals on farms.

Fisheries make up an important subsector in the Indonesian economy, since this country is an archipelago with long coastlines. However, there is no complete series of production data for this subsector. Table 17 shows the level of production of marine and inland fisheries for selected years.

The level of production of marine fisheries has been much higher than that of the inland fisheries since the early period of the Republic. In 1951 production from marine fisheries was 1.7 times that of inland fisheries. During the postwar reconstruction period and half of the guided economy period, inland fisheries grew at 5.3 percent a year as compared to 3.8 percent for marine fisheries. Licenses given to foreign fishing enterprises resulted in increased growth rates in production from marine fisheries. From 1971 to 1978 the production rose more than 450 thousand tons with an average growth rate of more than 6.5 percent a year. Inland fisheries declined slightly in the same period. The areas of brackish water ponds, fresh water ponds and paddy fields under fish culture have been declining.

TABLE 16

ESTIMATED GROWTH RATES OF MEAT PRODUCTION BY KIND OF LIVESTOCK IN INDONESIA, VARIOUS PERIODS

Livestock	Annual growth rate[a]		
	1950-1958	1959-1966	1967-1978
		percent	
Cattle	2.67	2.78	0.63
Buffalo	-1.24	1.17	4.68
Goats/sheep	4.11	3.62	10.71

[a]Estimated by regressing the logarithm of number of livestock slaughtered on time using data in Table A-12. The regression coefficients are presented in Table B-5.

TABLE 17

PRODUCTION OF MARINE AND INLAND FISHERIES IN INDONESIA, SELECTED YEARS

Year	Level of production		
	Marine Fisheries	Inland Fisheries	Total
		1,000 tons fresh fish	
1951	323.84	185.10	508.94
1958	421.04	265.99	687.03
1962	507.21	373.46	880.67
1971	820.45	424.11	1,244.56
1978	1,277.39	420.28	1,647.66

Source: Statistical Pocketbook of Indonesia, various issues.

CHAPTER V

PRODUCTIVITY GROWTH

Total Productivity

Translog-Model Structures

Estimation of the total-productivity growth rate, as discussed in Chapter II, requires the estimates of the rate of change of DVA (dF/F), factor-input changes (dZ) and competitive income share per unit of input (G_z/G). The dF/F was estimated by regressing the logarithm of DVA on time and the elements of dZ by regressing each of the primary inputs on time. G_z/G was estimated with a translog model of SVA. For the 1950-78 period, the structures of the model of SVA and DVA are presented in Table 18. For the three policy strategy periods, the regression coefficients, which were estimated by applying ME procedure, are presented in Table 19.

SVA is defined as the NVA deflated by the aggregate-price index (1960 = 1.00) and DVA is the value added at constant prices of outputs and inputs (billion rupiahs of 1960). Normalized price of intermediate inputs is the price index of the inputs (1960 = 1.00) divided by price index of the output (1960 = 1.00). Acreage of agricultural land consists

TABLE 18

ESTIMATED REGRESSION COEFFICIENTS FOR THE TRANSLOG MODEL ON SINGLE- AND DOUBLE-PRICE DEFLATED VALUE ADDED (SVA AND DVA), 1950-1978

Regressors	Dependent variable[a]			
	ℓnG		ℓnF	
	Coefficients	Standard errors	Coefficients	Standard errors
Constant term	-39.0605	230.9193	131.8054	45.3910
ℓnR	-7.0219	8.2748	1.1679	1.6265
ℓnZ_1	-98.2032	314.2805	53.6825	61.7771
ℓnZ_2	149.8314	476.2008	-176.2189	93.6052
ℓnZ_3	-28.2727	75.4147	35.6697	14.8240
ℓnR*ℓnR	-0.0677	0.5077	-0.0099	0.0998
ℓnZ_1*ℓnZ_1	-31.6812	117.0126	5.9190	23.0008
ℓnZ_1*ℓnZ_2	172.4918	379.0220	-40.0824	74.5031
ℓnZ_1*ℓnZ_3	-62.5410	65.5147	9.6765	12.8780
ℓnZ_2*ℓnZ_2	-148.2931	294.1137	58.8619	57.8130
ℓnZ_2*ℓnZ_3	72.5033	93.9806	-20.3825	18.4735
ℓnZ_3*ℓnZ_3	-3.3330	9.5253	0.4067	1.8724
ℓnR*ℓnZ_1	-6.3270	6.7961	0.4345	1.3359
ℓnR*ℓnZ_2	12.2637	8.9470	-1.1540	1.7587
ℓnR*ℓnZ_3	-3.3276	1.4586	0.2968	0.2867
	$\bar{R}^2$ = 0.848266		$\bar{R}^2$ = 0.993870	
	n = 29		n = 29	

[a] G symbolizes SVA (based on Table A-13 and Table A-15) and F represents DVA (Table A-14); both are in billion of 1960-rupiahs. R stands for the normalized price of intermediate inputs (1960=1.00, based on Table A-15 and Table A-17); Z_1 is the acreage of agricultural land (million hectares, Table A-1), Z_2 is labor force engaged in agriculture (million workers, Table A-2); Z_3 is fixed capital (billion 1960 rupiahs, based on Tables A-3, A-4, A-5, and A-6); ℓn symbolizes natural logarithm, $\bar{R}^2$ is corrected coefficient of determination; and n represents the number of observations.

TABLE 19

ESTIMATION OF THE REGRESSION COEFFICIENTS FOR THE TRANSLOG MODEL ON SINGLE- AND DOUBLE-PRICE DEFLATED VALUE ADDED (SVA AND DVA) IN INDONESIAN AGRICULTURE BY PERIOD

Regressors	Dependent variable[a]					
	ℓnSVA			ℓnDVA		
	1950-58	1959-66	1967-78	1950-58	1959-66	1967-78
Constant	9.294800	-21.492900	0.361507	0.288900	-1.633285	-6.262820
ℓnR	-0.578289	0.010772	-0.021036	0.022105	0.020242	-0.013406
ℓnz_1	0.648245	2.685830	0.271049	0.629257	0.198414	0.133560
ℓnz_2	-0.980580	16.171300	1.222490	0.098588	1.796100	1.918920
ℓnz_3	-1.075740	-0.221815	-0.068699	-0.031899	-0.015297	0.339908
ℓnR*ℓnR	-0.807367	-0.451404	0.059101	-0.138589	0.011602	0.024740
$\ell nz_1 * \ell nz_1$	0.613917	0.158854	-0.024534	0.145325	0.010254	-0.083009
$\ell nz_1 * \ell nz_2$	0.372528	-1.993100	-0.009822	0.098487	0.039702	-0.025815
$\ell nz_1 * \ell nz_3$	0.225854	0.532784	0.052366	0.030974	0.045185	-0.122761
$\ell nz_2 * \ell nz_2$	0.486037	-1.661380	0.007108	0.073960	0.012796	-0.178476
$\ell nz_2 * \ell nz_3$	-0.225949	-0.880649	0.130956	-0.004768	-0.070009	1.068870
$\ell nz_3 * \ell nz_3$	-0.056560	0.416679	-0.074003	-0.002626	0.028011	-0.390891
$\ell nR * \ell nz_1$	0.209018	0.017878	-0.003108	0.011607	-0.031722	-0.004277
$\ell nR * \ell nz_2$	0.159480	0.006963	-0.003444	0.009817	0.006623	-0.006426
$\ell nR * \ell nz_3$	0.120045	0.003553	-0.004676	0.005897	0.004637	-0.003528
	n = 9	n = 8	n = 12	n = 9	n = 8	n = 12

[a]Estimated using the maximum-entropy (ME) procedure because of under size samples. An elaboration on the estimation procedure is presented in Appendix C-1. For notation see the footnote of Table 18.

of arable and permanent-crop lands (million hectares). Labor force is measured in number of workers engaged in agricultural activities. And, fixed capital is composed of irrigation facilities (estimated based on irrigated areas), tractors and equipment used in agriculture, fishing boats, and livestock capital, all at 1960 constant prices.

Productivity Growth Estimates

Real value added in agriculture has increased from year to year since 1950. Drops in value added of food crops took place in 1955, 1963, 1967 and 1977 (Fig. 3). In many cases these drops were associated with unfavorable weather conditions and/or widespread pests or diseases. Appendix Table A-8 and Table A-9 show some reductions in harvested areas and production of rice, the overwhelmingly dominant food crop, in these years. Except in 1967, these reductions were accompanied by some drops in harvested areas and production of maize, sweet potatoes, soybeans, and peanuts. The fall in food crop production caused a drop in value added in 1963 and 1967. In 1955 and 1977 the effect was offset by increases in export crops and to some extent by livestock production.

A decline in commercial-crops value-added took place in 1973 due to some declines in the yield of coffee and tobacco. However, this decline was more than offset by an increased production in forests, fisheries and food crops.

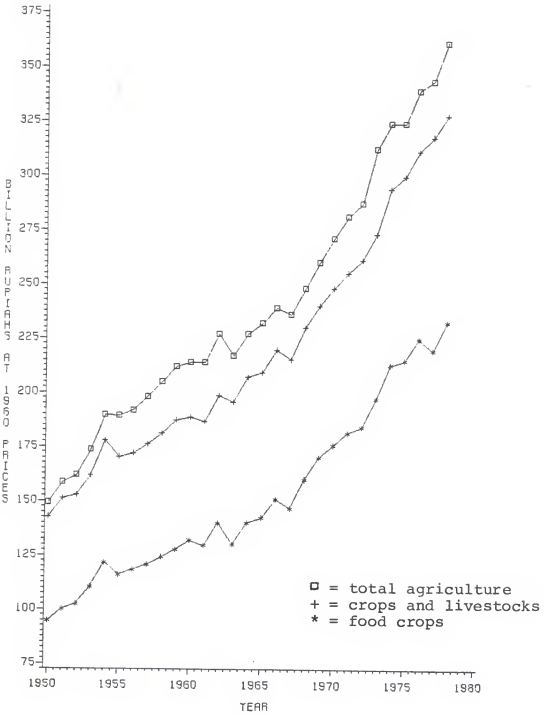

Fig. 3. Trends of real value added in the agricultural sector in Indonesia by various categories, 1950-1978.

An estimate for the whole period 1950-78 showed a 2.82 percent average annual growth rate of agricultural value added (Table 20). Total income share of primary inputs--land, labor, and fixed capital--grew at 2.22 percent a year. Therefore, by equation (26) the total productivity of the agricultural sector grew at 0.60 percent a year (see Appendix C-1 for procedure).

When broken down into the three distinct periods, the average growth rate of value added was 3.93 percent in the 1950-58 period, 1.64 percent in 1959-66, and 3.79 percent in 1967-78. The substantial drop in the average growth rate of gross value added in 1959-66, while the growth rate of factor share was still high, reflected a serious decline in the total productivity of this sector. The rate dropped from 0.45 percent a year in the postwar reconstruction period to -1.99 percent annually in the years of the guided economy.

During the new order period, the value added increased at an average rate close to that of postwar reconstruction years. However, the growth rate of factor share of primary inputs was lower so the productivity growth rate was higher--1.57 percent annually. Public expenditures for extensions and researches to support agricultural growth have been increased substantially since REPELITA I.

Centralized control, domestic political rivalries, and unproductive spending were some of the factors which

TABLE 20

GROWTH RATES OF VALUE ADDED, FACTOR SHARES AND TOTAL PRODUCTIVITY OF INDONESIAN AGRICULTURE, VARIOUS PERIODS

Period	Annual growth rate		
	Gross value added[a]	Factor share[b]	Total productivity[c]
		percent	
1950-1958	3.93	3.48	0.45
1959-1966	1.64	3.62	-1.99
1967-1978	3.79	2.22	1.57
1950-1978	2.82	2.22	0.60

[a]Denoted as dF/F and estimated by regressing the logarithm of DVA on time based on data in Table A-14.

[b]Defined as $(G_Z/G)'dZ$ of equation (26). G_Z/G is a vector each of its elements is a function of R, Z_1, Z_2, and Z_3. The functions were derived from the translog models (Table 18 and Table 19). Elements of vector dZ were estimated by regressing Z_i's on time based on data in Tables A-1, A-2, A-3, A-4, A-5 and A-6, as defined in the footnotes in Table 11. For the computation procedure, see Appendix C-2.

[c]Defined as $dF/F - (G_Z/G)'dZ$.

led the economy to sluggish output growth, high inflation, and decline in productivity in the years of guided economy. Increases in the amount of fixed capital in agriculture, expansion of land area, and allocation of more labor in postwar reconstruction period gave a high average growth rate of value added. Total productivity was rising, but the rate was relatively low--perhaps due in part to low managerial skill of farmers, low quality of laborers, a lack of adaptable technology, and limited technical inputs.

Partial Productivity

Land, labor, and fixed capital were considered to be the primary inputs in this study. Land is very limited in several parts of the country, notably Java, Madura, and Bali. In these areas an increase in productivity of land is obviously crucial. In other areas--Kalimantan, Irian Jaya, part of Sumatra and Sulawesi--labor and capital are the limiting factors.

Partial productivity indexes were measured as the indexed ratio of real value added to only one factor of production. Year to year movement of the productivity indexes are shown in Fig. 4, and the growth rates are presented in Table 21. For the entire period 1950-78, labor showed the highest productivity growth rate, 1.93 percent, as compared to 1.81 percent for land productivity and 0.96 percent for fixed capital.

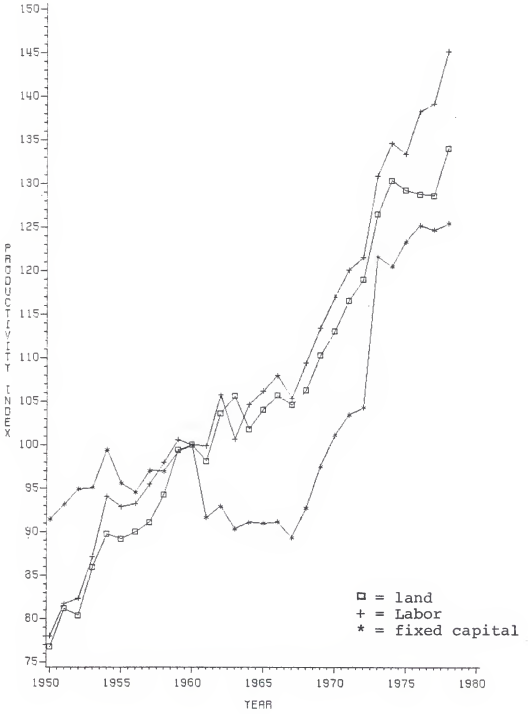

Fig. 4. Partial productivity indexes (1960=100) in Indonesian agriculture, 1950-1978.

TABLE 21

ESTIMATED GROWTH RATES OF PARTIAL PRODUCTIVITIES OF PRIMARY INPUTS IN INDONESIAN AGRICULTURE BASED ON VALUE ADDED, VARIOUS PERIODS

Period	Productivity growth rate		
	Land	Labor	Fixed capital
	percent annually[a]		
1950-1958	2.39	2.82	0.59
1959-1966	0.90	1.05	-1.32
1967-1978	2.30	2.85	3.40
1950-1978	1.81	1.93	0.96

[a]Estimated by regressing the logarithm of partial productivity indexes on time, based on DVA per unit of primary input presented in Table A-19. The regression coefficients are in Table B-6.

Comparison of partial productivities for all factors showed an already familiar pattern--a drop from the first to the second period and then an increase from the second to the third period. Productivity of land grew at an average annual rate of 2.39 percent in the postwar reconstruction period, fell to 0.90 percent in the years of the guided economy, and then rose to 2.30 percent in the new order era. Land showed a similar pattern, except that when the average rate rose in the latest period it exceeded that of the postwar reconstruction years. The average growth rate was 2.82 percent in the first, 1.05 percent in the second, and 2.85 percent in the third period. The largest variation between periods was shown by fixed capital--the average annual rate changed from 0.59 to -1.32 then to 3.40 percent.

The high growth rate of land productivity in the first nine years of the 1950's is attributed to the rapid growth of irrigation facilities--serviced areas increased from 3.52 million hectares in 1950 to 4.36 million hectares in 1958, an increase of roughly 2.7 percent a year. The irrigated areas declined slightly from 1959 to 1966, then rose again in the new order years at a rate of around 2.1 percent a year.

Close relationships among productivities of factors could be observed. Better quality of land as a result of increased irrigation and land improvement, gave way to higher productivity of labor. The somewhat higher labor productivity in the third period as compared to that in the

first period can be attributed in part to increased schooling of farmers, greater expenditures on extension and research, and increased availability of technical inputs such as high yielding varieties, fertilizers, and farm chemicals. And the high productivity growth rate of fixed capital in the latest period could be related to the improving quality of land and labor. The positive relationship between the amount of one input used and the partial productivity of another input is explained by the definition of the later which follows the concept of average productivity.

Inter-Country Comparison

Estimated agricultural growth and productivity rates in Indonesia and several other developing countries in the tropical zone are shown in Table 22. It should be recognized that the figures were estimated on different bases. For Indonesia, the productivity was estimated based on a restricted profit function. A production function approach was used in estimating Mexico's rates, while the rates for the other countries were estimated from accounting data. The estimates were also based on different periods.

In terms of total productivity, Mexican agriculture during the 1940-65 period showed a high average growth rate of 2.0 percent a year on an output basis. However, when the contribution of inputs were estimated using the weights based on a cross sectional production function, the average

TABLE 22

GROWTH RATES OF OUTPUT, VALUE ADDED AND TOTAL PRODUCTIVITY OF AGRICULTURE IN SELECTED COUNTRIES, VARIOUS PERIODS

Country and period	Growth rate			
	Output	Value-added	Total productivity	
			Output basis	Value-added basis
		percent annually		
Indonesia				
1950-1958	.	3.93	.	0.45
1959-1966	.	1.64	.	-1.99
1967-1978	.	3.79	.	1.57
1950-1978	.	2.82	.	0.60
Mexico				
1940-1953	4.7	.	1.7 (0.0)[a]	.
1954-1965	3.7	.	1.9 (0.6)	.
1940-1965	4.7	.	2.0 (0.4)	.
The Philippines				
1950-1956	5.2	5.2	1.5	1.7
1956-1959	2.0	1.7	-1.4	-1.1
1959-1969	3.8	3.6	0.8	1.2
1950-1969	4.0	3.8	0.7	1.0
Taiwan				
1913-1937	3.6	3.0	1.0	1.4
1937-1946	-4.9	-3.9	-2.5	-2.7
1946-1970	5.6	4.8	1.7	3.2
1913-1970	3.0	2.6	0.7	1.5
Korea				
1920-1939	1.62	1.38	-0.01	0.94
1939-1953	-0.32	-0.36	-0.36	0.22
1953-1969	4.36	4.27	1.95	2.76
1920-1969	1.94	1.81	0.52	1.32

Source: Tables 13 and 20 for Indonesia, Hertford (1971: 17-18) for Mexico, David and Barker (1979:131) for the Philippines, Lee and Chen (1979:72) for Taiwan and Ban (1979:101) for Korea.

[a]Rates in parentheses are based on cross-section production function.

growth rate was reported to be low, 0.4 percent annually. On the same basis Korean agriculture for the extended period 1920-69 showed a relatively low average annual growth rate of productivity, 0.52 percent, but the postwar period, 1953-69, showed a high rate, 1.95 percent.

A negative growth rate of agricultural productivity was experienced by Indonesia in the period 1959-66. The Philippines, Taiwan, and Korea experienced negative growth rate of agricultural productivity in the period 1956-59, 1937-46, and 1939-53, respectively. Productivity changes in different periods of time are due in part to domestic problems as well as to world market situations. Indonesian domestic problems and policies in the period 1959-66 have been discussed in the previous section. Other causes of differences in productivity growth rates are the initial resources endowed, the population growth rates, and the rate of labor absorption by non-agricultural sectors.

Negative growth rate of land productivity as well as that of labor occurred in the Philippines in the period 1956-59 and in Taiwan in the period 1937-46 (Table 23). In all of the three periods under consideration, Indonesia did not experience a negative growth rate in partial productivities of land and labor. The average growth rates of land and labor productivities of Indonesian agriculture of 1950-78 were relatively high as compared to those of the Philippines, 1950-69, but lower than those of Korea of the 1953-69 period, and of Taiwan agriculture, 1946-70. Taiwan

TABLE 23

GROWTH RATE OF PARTIAL PRODUCTIVITIES OF LAND AND LABOR IN AGRICULTURE IN SELECTED COUNTRIES, VARIOUS PERIODS

Country and period	Rate of productivity growth					
	Output basis			Value-added basis		
	Land	Labor	RCF[a]	Land	Labor	RCF[a]
			percent			
Indonesia						
1950-1958	.	.	.	2.39	2.82	85
1959-1966	.	.	.	0.90	1.05	86
1967-1978	.	.	.	2.30	2.85	81
1950-1978	.	.	.	1.81	1.93	94
The Philippines						
1950-1956	1.8	2.3	74	1.7	5.8	29
1956-1959	-1.3	-0.2	650	-1.5	-0.5	300
1959-1965	1.6	1.5	107	1.6	1.4	114
1965-1969	2.3	1.8	128	1.9	1.5	127
1950-1969	1.3	1.5	87	1.2	1.4	86
Taiwan						
1913-1937	2.7	2.9	93	2.1	2.3	91
1937-1946	-4.7	-3.6	131	-3.6	-2.5	144
1946-1970	5.2	4.6	113	4.4	3.8	116
1913-1970	2.5	2.5	100	2.2	2.1	105
Korea						
1920-1939	1.52	1.14	133	1.28	0.90	142
1939-1953	0.36	0.53	68	0.33	0.51	65
1953-1969	3.29	2.49	133	3.20	2.40	133
1920-1969	1.76	1.40	126	1.63	1.28	127

Source: Table 21 for Indonesia, David and Barker (1979:135) for the Philippines, Lee and Chen (1979:79) for Taiwan, and Ban (1979:103) for Korea.

[a]RCF is the relative contribution of factors, land to labor.

and the Philippines showed a larger fluctuation of the partial-productivity growth rates from one period to another as compared to those of Indonesia and Korea.

Another interesting feature in this inter-country comparison was the relative contribution of land to labor. The Philippines showed very large changes--especially in the 1956-59 period. In Indonesian agriculture, during the 1950-78 period, the changes of the relative contribution (RCF) were relatively small which is explained in part by the very small changes in land per worker (Table A-20). Values of RCF under 100 for Indonesia imply that labor productivity increased faster than the productivity of land in all periods. This result is related to the higher growth rate of land area compared to labor force in agriculture--1.02 percent annually for land and 0.90 percent for labor (Table 11).

CHAPTER VI

ESTIMATES OF ELASTICITIES, DERIVED DEMANDS FOR INTERMEDIATE INPUTS, SHADOW PRICES OF PRIMARY INPUTS, AND TECHNICAL CHANGE BIAS

Effects of changes in the prices of outputs and current inputs as well as changes in the amount of primary inputs on production were observed from responses of value added. To measure the magnitude of such responses elasticities of value added were estimated. Derived demand for intermediate inputs and shadow prices of basic factors were two other concepts used to analyze the relationship between prices and the level of production. Technical change biases brought about by the growth of production were also estimated. These biases help describe the appropriateness of production policies with regard to the relative availability of basic factors.

Price and Input Elasticity of Value Added

The elasticity of real value added with respect to normalized price of intermediate inputs in Indonesian agriculture during the period under study was estimated, using the translog model, to be -0.03 (Table 24). This implies that as the relative price of input to the price of output

TABLE 24

PRICE AND INPUT ELASTICITIES OF VALUE ADDED IN INDONESIAN AGRICULTURE, 1950-1978

	Elasticity[a]
Normalized price of intermediate inputs	-0.03
Agricultural land	0.40
Labor force	2.04
Fixed capital	0.18

[a]Based on results from the trancendental logarithmic model for the real value added (DVA).

declines by 1 percent, the real value added could be expected to increase by around 0.03 percent.

Several reasons may be offered to explain the inelastic response of value added to price changes. Firstly, the efficiency of fertilizers, farm chemicals, and improved varieties are very much tied to irrigation and the irrigated area represents no more than one-fourth of total agricultural land. Secondly, fertilizers, farm chemicals, seeds and feed are not inputs in fisheries and forestry--two components of agricultural value added. Thirdly, import prices may not correctly represent the prices paid by the farmers due to subsidies and other forms of market interventions imposed by the government.

Addition of 1 percent of land area could be expected to bring about an increase of 0.40 percent in real value added. One percent increase in labor force seems to give the highest impact on agricultural value added. The elasticity of real value added with respect to labor was 2.04 and with respect to fixed capital it was estimated to be 0.18.

Elasticity of Derived Demand and Shadow Price

Elasticity of Derived Demand for Intermediate Inputs

Producer response to any change in input and output prices is reflected in the changes in inputs demanded. In

a mixed duality analysis the demand function is obtained by using equation (14a), i.e. the negative of derivative of single price deflated value added with respect to the normalized price of input under consideration. The magnitude of the response could be conveniently measured by the elasticity of derived demand.

Table 25 shows the estimated elasticities of derived demand for intermediate inputs with respect to the normalized price of intermediate inputs and the primary factors of production. A reduction of 1 percent in relative price of intermediate inputs to price of output could be expected to raise the amount of intermediate inputs demanded as much as 4.9 percent. One percent increase in land could bring about 0.13 percent increase in intermediate inputs demanded. Estimated elasticities of demand for intermediate inputs with respect to labor and fixed capital were 0.14 and 0.20, respectively.

Agriculture is still very subsistence in nature in Indonesia. Most of the farms, particularly those operating in food production are small and a large portion of the output is consumed by the farmers' families. Along this line, fertilizers and perhaps also farm chemicals are used only by a portion of the crop growers, and feed grains are bought by only a portion of livestock producers. Buffaloes, cattle, goats and sheep depend mostly on grass from herding in open fields.

TABLE 25

ELASTICITY OF DERIVED DEMAND FOR INTERMEDIATE INPUT WITH RESPECT TO ITS RELATIVE PRICE, AND TO THE AMOUNT OF PRIMARY INPUTS IN INDONESIAN AGRICULTURE, 1967-1978

Source	Elasticity of derived demand[a]
Normalized price of input	-4.93
Acreage of agricultural land	0.13
Labor force	0.14
Fixed capital	0.20

[a]Estimates were based on the regression coefficents of the translog model for SVA (Table 19)

Shadow Price of Primary Inputs

For primary inputs, shadow prices provide evidence of how these inputs constrain production. By using equation (14b) and the regression coefficients for SVA, the following shadow price functions were derived:

$$W_1^* = -1597.91 - 1031.00\ell nZ_1 + 2806.70\ell nZ_2 - 1017.64\ell nZ_3 - 102.95\ell nR$$

$$W_2^* = 1517.35 + 1808.99\ell nZ_1 - 3110.42\ell nZ_2 + 760.371\ell nZ_3 + 128.61\ell nR$$

$$W_3^* = -80.774 - 178.68\ell nZ_1 + 207.14\ell nZ_2 - 19.045\ell nZ_3 - 9.507\ell nR$$

where: W_1^*, W_2^* and W_3^* are the optimum shadow prices of land, labor, and fixed capital, respectively (billion of 1960 rupiahs); Z_1 is agricultural land area (million hectares); Z_2 labor force engaged in agriculture (million workers per year); Z_3 is fixed capital (billion 1960-rupiahs); and R is normalized price of current inputs based on price index (1960=100) of inputs divided by price index (1960=100) of outputs.

Each of the shadow prices, as shown by the above functions, has a negative relationship with the respective amount of input, that is, as the basic factor brought into production increases its shadow price will fall. Furthermore, one can notice that as the farmers bring more fixed capital into the production process, the shadow price of land will decline and hence profit maximizing farmers will increase the acreage of farm land. On the other hand,

shadow price of labor will go up and will lead to a drop in the amount of labor being applied. These results imply that fixed capital and agricultural land are complementary to each other, while labor was a substitute for fixed capital as well as for land.

Technical Change Biases

Agriculture is a biological-chemical type of industry. Its technical progress can be observed through the trends of current inputs such as fertilizers, farm chemicals, seeds, and fuels being used in production. Table 12 (page 71) shows a very high rate of increase in the use of fertilizers. Except in the mid-1960's, the use of farm chemicals also increased steadily. As indicated by the ever increasing number of tractors (Table A-4) and motorized fishing boats (Table A-5), the use of fuel must have been rising. All of these trends suggest that there has been a steady process of adopting new technologies in Indonesian agriculture.

A decreasing income shares of fixed capital has accompanied the technical progress. As shown in Table 26, the technical change bias with respect to capital is negative (-0.28) which means that the production growth has been capital saving. Zero coefficient with respect to labor implies a labor neutral technical change. And with respect to land the change has been very slightly augmenting--the coefficient is 0.01.

TABLE 26

ESTIMATED COEFFICIENTS OF TECHNICAL CHANGE BIASES IN INDONESIAN AGRICULTURE, 1950-1978

Source	Bias Coefficient of technical change[a]
Agricultural land	0.01
Labor force	0.00
Fixed capital	-0.28

[a]Estimates based on equation (29) in Chapter II. For the computational procedure, see Appendix C-3.

Capital saving growth is commonly pursued by less developed countries due to the scarcity of this productive factor. The neutral technical change with respect to labor and close to neutral with respect to land could be explained by the fact that Indonesia is composed of two groups of regions which differ substantially in man/land ratios. In Java, Madura and Bali--where the ratios are very high--the expansion of agricultural land areas has been very limited. Therefore, a labor augmenting and land saving technological change can be expected. On the other hand, the outer islands--Kalimantan, Sumatra, Sulawesi, Irian Jaya, and others--provide the opportunities for land expansion and facilitate a labor saving and land using technological change.

CHAPTER VII

SUMMARY, CONCLUSIONS, IMPLICATIONS AND LIMITATIONS

Summary

The burden of importing food, the need for greater foreign earnings to finance development, and the urgency to increase per capita income have been the major forces that have led to an emphasis and re-emphasis on agricultural development since the early years of the Republic of Indonesia. There have been increases in the production of food as well as non-food commodities. However, the rate of growth has not been satisfactory. Imports of staple food commodities have increased to levels that make Indonesia the main importer in the world rice market. Export earnings from agriculture have grown relatively slow, particularly in the years prior to 1967.

An equitable distribution of income was a major goal in the third REPELITA (five year plan) and placed added importance on agricultural development. Land expansion and intensification were two efforts to raise per capita output and income in this plan. Increases in output per worker--which is perhaps the only way to increase wage without causing inflation--and conservation of natural resources

were two important goals in the efforts to increase productivity.

This study was concerned primarily with analyzing the growth of agricultural productivity and relating it to the three basic development strategies which Indonesia has followed since independence. Specific objectives were to describe agricultural growth and policies; to measure the rate of productivity growth; to estimate the effects of changes in intermediate input prices and amounts of primary inputs on aggregate output; to analyze the technical change biases; and to relate the growth of production and productivity to the three basic development strategies.

The main feature of this study was an application of duality theory in an aggregate analysis. Using the concept of value added as a restricted profit function, the rate of growth of total productivity was estimated. Partial productivity growth of each primary factor was also estimated on a value-added basis.

Responses of production to changes in the prices of outputs and intermediate inputs and in the amount of primary factors in production were presented in the form of elasticities of real value added and of derived demand for intermediate inputs. Shadow prices of primary inputs were estimated in functional forms. The functional relationships were used to observe the complementarity-substitutability of productive factors. Technical change bias was estimated

using the restricted profit function in order to analyze the consequences of change on inputs.

The growths of inputs, production, value added, and productivity were also measured for the three distinct policy periods. Each period was characterized by specific policy features to encourage development. The relationships between the changes in development strategy and the trends in production and productivity were considered.

Conclusions

In the period 1950-78 fixed capital grew at an average rate of 1.78 percent per year--considerably higher than the growth rate of land and labor which were 1.02 and 0.90 percent, respectively. The growth patterns of land and labor were similar--slowing down in the period 1959-66 and then rising again in the period 1967-78. Fixed capital showed a continual drop in average growth rate from period to period.

Consumption of fertilizers has increased rapidly since the beginning of the Republic in 1950. The average annual consumption of nitrogen, phosphate and potash in the second REPELITA were, respectively, more than 28, 26, and 18 times that of the first four years of the postwar period. The rapidly growing fertilizer consumption has been supported by the development of nitrogen fertilizer plants which began operating in 1963. The use of chemicals for plant protection has also grown except in the mid 1960's

during the confrontation over Irian Jaya. The use of modern varieties of rice from IRRI have helped increase the growth of rice production since the late 1960's.

Agricultural production grew at 3.99 percent annually in the postwar reconstruction years (1950-1958). This average rate dropped to 1.66 percent in the guided economy period (1959-1966), and rose to 3.80 percent in the new order years (1967-1978). The food-crops commodity group has shown a substantially higher growth rate than that for total agriculture in the postwar reconstruction years. The second and third periods, however, had smaller growth rates of food-crops production relative to that for total agriculture. While rice showed the highest growth rate ever in the new order years, other food crops grew at lower rates than those in the postwar reconstruction period. Increases in rubber production began again in the late 1950's after a number of years of declines. Coffee production had highest average growth rates in the years of the guided economy and oil palm in the new order period. Coconut, tea, and tobacco production began upward trends in the late 1960's.

Meat production, except beef, grew rapidly in the new order years. The rapid slaughtering of buffaloes, however, has resulted in a declining trend of its population in the last decade and, consequently, a smaller productive capacity for the near future.

Marine fisheries have always produced more than inland fisheries. Inland fisheries showed a high growth rate

in production until the early 1960's. Production by marine fisheries has accelerated since the late 1960's through modernization of equipment and licensing of international firms.

During the period 1950-78 gross value added increased at an average rate of 2.82 percent annually. The total income share of primary inputs grew at an annual rate of 2.22 percent. Therefore, the net productivity growth rate of the agricultural sector was 0.60 percent annually. Estimation by period showed that the average annual growth rate in the postwar reconstruction period was 0.45 percent, -1.99 percent in the years of guided economy, and 1.57 percent in the new order period.

Each factor showed a falling average annual growth rate of partial productivity from the first to the second period, and a rising rate from the second to the third period. On a value-added basis the annual growth rate of partial productivity of land was 2.39 percent in the postwar reconstruction period, 0.90 percent in the period of guided economy, and 2.30 percent in the new order years. A similar pattern was shown by labor which fell from 2.82 to 1.05 and then rose to 2.85 percent. The greatest variation was shown by fixed capital with growth rates of 0.59, 1.32, and 3.40 percent annually in the three periods, respectively. Estimated partial productivities of land, labor and fixed capital for the period 1950-78 were 1.81, 1.93, and 0.96 percent, respectively.

Elasticity of value added with respect to normalized price of intermediate inputs was -0.03. As the price of intermediate inputs, relative to output prices, decreased by 1 percent the real value added was estimated to increase by 0.03 percent. An addition of 1 percent of agricultural land would bring about an estimated increase of 0.4 percent in agricultural real value added. The estimated elasticities of value added with respect to labor and fixed capital were 2.04 and 0.18 percent, respectively.

The elasticity of demand for intermediate inputs with respect to own relative price was estimated to be -4.9.

The estimated shadow price for each primary input, as one would expect, had a negative relationship with the amount brought into production. The estimated shadow price functions showed a complementarity between fixed capital and land, and a substitution between fixed capital and the labor force.

Estimated coefficients indicated a slightly land using and a labor neutral and a capital-saving bias in the technological change brought about by agricultural growth during the period 1950-78.

Some Implications for Policy

As part of a broader economic system, agricultural growth naturally depends on the economic strategy adopted. Inappropriate monetary and fiscal policies that created high inflation rates during the guided-economy era, combined with

policies which neglect price parity, were destructive to agricultural growth and productivity.

Emphasis on irrigation combined with a diversification strategy was helpful in increasing food production in the postwar reconstruction period. And, research on better varieties together with reasonable price of fertilizers, easy credit and guaranteed price floors enabled the new order administration to increase rice production substantially in the last decade.

Productivity growth in Indonesian agriculture has been relatively modest and the levels of production per hectare as well as per worker have been generally low. The opportunity to raise agricultural productivity remains a viable option. Such increases are needed to meet the rapid increasing domestic demand for food commodities and to prevent declining agricultural export earnings.

A very elastic demand indicates that reduction in the price of intermediate inputs (relative to the output prices) would substantially increase in the demand for inputs which, in turn, would raise the level of value added and hence productivity. The response could be accelerated by land reclamation and development and by allocating more fixed capital to the agricultural sector.

Fixed capital in the form of tractors and working animals facilitate an expansion of agricultural production onto new land. Some such capital would also substitute for some of the agricultural labor force which could raise the

unemployment rate if the discharged laborers were not absorbed by the other sectors of the economy. Mechanization should, therefore, be undertaken with careful calculations--particularly in regions where the man-land ratio is high. Whenever non-agricultural sectors are expanding and able to absorb a substantial number of workers, farm mechanization could be encouraged. The type of power equipment should be appropriate for a labor-abundant system so that the labor-discharging effect in agriculture occurs at a socially acceptable rate.

Technical changes seem to be on the right path--capital saving for the whole region. Land saving and labor using in Java, Madura and Bali was offset by land using and labor saving in outer islands which resulted in a neutral technological change with respect to labor and close to neutral with respect to land. Capital is the key to foster progress in agriculture.

Implications for Future Research

Agricultural productivities in Indonesia have grown considerably since the late 1960's. Another important aspect to observe is how the growth has benefitted the farmers, laborers, resource owners, traders, and consumers. How the fruits of the development have reached or failed to reach the real "target group," which is presumably the people in the lowest income bracket, is essential to measure the degree of success of economic developments.

Productivity growth rates have been shown to differ substantially among periods with different basic policy strategies. Studies aimed at more clearly understanding the factors affecting the growth rates are a continual need. The information obtained from such a study would be valuable in formulating policy.

Diversities in population density, natural resources, and in type of economic activities are substantial in Indonesia. Analyses by region would be helpful for further understanding the productivity growth in this archipelago country. Formulation of appropriate policies to promote optimal growth and regional-income equity requires the results of region-by-region study. Data for such studies are currently inadequate.

Limitations of Data

The data series used in this study were in many cases from more than one source, and discrepancies among sources existed. Adjustments had to be made to connect the broken series and to unify the definition of each variable. As a consequence errors in variables exist which will affect the estimates obtained.

Also the concept of a stock resource was applied to measure the primary inputs--land, labor and fixed capital. Data did not exist to measure the flow of resource services. For labor and fixed capital, stock levels may not capture the short-run changes in the amount of the factors used in production.

This concept, however, has been widely used, particularly in less developed countries.

The labor force in agriculture by years, as in other less developed countries, is not available. The available five-year-interval series required interpolation for interim years. This interpolation again added to errors in variables.

Prices of fertilizers and farm chemicals were based on import prices. Such prices may not correctly represent those paid by farmers due to market intervention by the government, especially during the guided economy period when the markets were controlled.

APPENDIX A

TIME-SERIES DATA

TABLE A-1

AGRICULTURAL LAND AREAS IN INDONESIA, 1950-1978

Year	Total agriculture land[a]	Arable land[b]	Permanent crop land[c]
		million hectares	
1950	14.71	11.58	3.13
1951	14.78	11.61	3.17
1952	15.24	11.60	3.64
1953	15.28	11.53	3.75
1954	15.98	11.75	4.23
1955	16.05	11.85	4.20
1956	16.12	11.79	4.33
1957	16.44	11.96	4.48
1958	16.44	11.97	4.47
1959	16.12	11.74	4.38
1960	16.18	11.74	4.44
1961	16.49	11.99	4.50
1962	16.56	11.98	4.58
1963	15.54	10.95	4.59
1964	16.86	12.30	4.56
1965	16.86	12.30	4.56
1966	17.10	12.60	4.50
1967	17.06	12.60	4.46
1968	17.65	12.90	4.75
1969	17.83	12.90	4.93
1970	18.13	13.00	5.13
1971	18.23	13.00	5.23
1972	18.25	13.00	5.25
1973	18.66	13.30	5.36
1974	18.78	13.30	5.48
1975	18.94	13.35	5.59
1976	19.91	14.17	5.74
1977	20.19	14.20	5.99
1978	20.37	14.27	6.10

[a]Sum of arable land and permanent-crop land.

[b]Based on 1964-1978 data from F.A.O. Production Yearbook, various issues, 1950-1962 data on per capita arable land from Statistical Pocketbook of Indonesia, 1957 and 1963 issues, and 1950-1978 series of six major annual-crop areas (see Table A-8).

[c]Based on 1964-1978 permanent crop areas estimated by F.A.O. Production Yearbook, various issues, and the series of six major perennial crop areas of 1950-1978 (see Table A-10).

TABLE A-2

POPULATION AND AGRICULTURAL LABOR FORCE IN INDONESIA, 1950-1979

Year	Popula-tion	Agric. labor	Year	Popula-tion	Agric. labor
	million			million	
1950	77.21	23.10	1965	105.41	26.37
1951	78.74	23.43	1966	107.64	26.71
1952	80.33	23.74	1967	109.96	27.04
1953	81.97	24.04	1968	112.38	27.36
1954	83.68	24.33	1969	114.88	27.67
1955	85.44	24.61	1970	117.59	27.97
1956	87.27	24.83	1971	120.15	28.24
1957	89.16	25.04	1972	123.12	28.50
1958	91.12	25.24	1973	126.09	28.77
1959	93.15	25.43	1974	129.08	29.02
1960	95.30	25.82	1975	132.11	29.28
1961	97.38	25.85	1976	135.19	29.59
1962	99.26	25.91	1977	138.34	29.77
1963	101.22	26.02	1978	141.11	30.01
1964	103.27	26.18	1979	143.94	30.26

Source: Population estimates from Statistical Pocketbook of Indonesia, various issues. Agricultural labor force based on I.L.O estimates of 1950, 1955, 1960, 1965, and 1970 (I.L.O. Labor Force Estimates and Projection, 1950-2000, 1977), and F.A.O. estimates of 1960, 1965, 1971, and 1975 through 1979 (F.A.O. Production Yearbook, various issues). Interpolation using a "three point formula" was made to estimate the figures in the years in between. The formula for data given in five years interval is

$$K_{t+1} = 0.72\ K_t + 0.36\ K_{t+5} - 0.08\ K_{t+10}\ ;$$
$$K_{t+2} = 0.48\ K_t + 0.64\ K_{t+5} - 0.12\ K_{t+10}\ ;$$
$$K_{t+3} = 0.28\ K_t + 0.84\ K_{t+5} - 0.12\ K_{t+10}\ ;$$
$$K_{t+4} = 0.12\ K_t + 0.96\ K_{t+5} - 0.08\ K_{t+10}\ ;$$

where K refers to the number of labor force and t denotes the t-th year.

TABLE A-3

AREA IRRIGATED IN INDONESIA, 1950-1978

Year	Irrigated area	Year	Irrigated area
	million hectares		million hectares
1950	3.52	1965	4.15
1951	3.65	1966	4.18
1952	3.75	1967	4.20
1953	3.97	1968	4.23
1954	4.03	1969	4.25
1955	4.07	1970	4.28
1956	4.20	1971	4.49
1957	4.24	1972	4.60
1958	4.36	1973	4.35
1959	4.38	1974	4.38
1960	4.40	1975	4.38
1961	4.08	1976	4.84
1962	4.30	1977	4.90
1963	3.93	1978	5.30
1964	4.13		

Source: 1964-1978 data are from F.A.O. Production Yearbook, various issues, 1950-1963 data are based on the series of irrigated paddy and "gogo rancah" attached to the F.A.O. estimates. The irrigated-paddy and gogo-rancah areas are from Statistical Pocketbook of Indonesia, various issues.

TABLE A-4

NUMBER OF TRACTORS USED IN AGRICULTURE, INDONESIA, 1950-1979

Year	Number	Year	Number
	thousand units		thousand units
1950	0.11	1965	6.00
1951	0.19	1966	6.50
1952	0.21	1967	7.00
1953	0.33	1968	7.50
1954	0.19	1969	8.00
1955	0.27	1970	8.50
1956	0.38	1971	9.00
1957	0.40	1972	9.20
1958	0.42	1973	9.70
1959	0.70	1974	10.00
1960	0.81	1975	10.50
1961	1.14	1976	10.80
1962	3.10	1977	11.30
1963	5.10	1978	11.80
1964	5.55	1979	13.95

Source: 1950-1951 are from U.N. Statistical Yearbook, 1953, 1952-1978 are from F.A.O. Production Yearbook, various issues, and F.A.O. Yearbook of Food and Agricultural Statistics, various issues.

TABLE A-5

NUMBER OF FISHING BOATS IN INDONESIA, 1950-1978

Year	Non-powered boats	Powered boats	Year	Non-powered boats	Powered boats
	thousand units			thousand units	
1950	71.26	0.04	1965	225.43	3.34
1951	80.25	0.12	1966	250.76	3.36
1952	90.37	0.33	1967	268.69	3.99
1953	92.64	0.75	1968	278.21	5.71
1954	96.84	0.80	1969	275.31	5.32
1955	123.90	0.67	1970	289.40	6.03
1956	129.23	0.76	1971	277.66	7.18
1957	138.00	0.90	1972	286.46	8.82
1958	154.29	1.43	1973	230.62	12.27
1959	175.58	1.46	1974	257.16	13.21
1960	167.98	1.46	1975	242.22	14.93
1961	195.43	2.21	1976	228.24	17.48
1962	206.84	2.87	1977	225.00	20.00
1963	212.68	2.99	1978	225.00	22.11
1964	231.66	3.20			

Source: Statistical Pocketbook of Indonesia, various issues.

TABLE A-6

NUMBER OF LIVESTOCK IN INDONESIA BY TYPE OF ANIMAL, 1950-1979

Year	Cattle	Buffalo	Goat & Sheep	Horse
		thousand head		
1950	4,261	2,734	6,576	510
1951	4,551	2,759	7,305	529
1952	4,469	2,351	7,345	549
1953	4,624	2,867	7,948	593
1954	5,025	2,924	9,479	606
1955	5,059	2,888	9,956	584
1956	5,158	2,856	9,816	618
1957	5,037	2,846	8,811	654
1958	5,081	2,866	8,380	654
1959	4,805	2,809	7,958	673
1960	4,947	2,861	7,742	657
1961	6,348	2,893	11,507	720
1962	6,584	2,803	10,917	731
1963	6,538	2,836	10,951	653
1964	6,537	2,836	10,960	653
1965	6,816	2,951	12,598	908
1966	6,790	3,021	12,086	906
1967	6,816	2,740	10,868	762
1968	6,576	2,870	10,838	654
1969	6,447	2,976	10,542	692
1970	6,130	2,976	9,698	692
1971	6,245	2,916	9,993	665
1972	6,260	2,825	8,059	696
1973	6,305	2,243	9,947	632
1974	6,263	2,628	10,698	615
1975	6,178	2,259	10,350	637
1976	6,193	2,256	10,391	624
1977	6,361	2,260	9,866	625
1978	6,423	2,312	11,662	615
1979	6,453	2,312	11,662	615

Source: Statistical Pocketbook of Indonesia, various issues.

TABLE A-7

INDEXES OF AGGREGATE PRODUCTION OF AGRICULTURE IN INDONESIA, 1950-1979

Year	Food crops	Total agriculture
	1960=100	
1950	59.41	65.28
1951	65.35	78.34
1952	72.28	83.78
1953	78.22	87.84
1954	90.10	95.95
1955	84.16	91.89
1956	85.15	91.89
1957	87.13	94.60
1958	94.06	97.30
1959	95.05	98.32
1960	100.00	100.00
1961	94.06	98.65
1962	103.96	106.78
1963	93.07	100.00
1964	101.98	106.76
1965	100.99	108.11
1966	107.92	110.81
1967	100.00	110.81
1968	111.88	116.44
1969	111.88	122.08
1970	120.79	136.48
1971	122.77	140.54
1972	117.82	144.60
1973	128.71	151.35
1974	138.61	155.41
1975	140.59	156.76
1976	143.56	155.41
1977	147.52	163.51
1978	160.40	175.68
1979	152.48	178.38

Source: Food-crop index and 1950-51 figures for total agriculture are from U.S.A.I.D. Statistical Report, No. 7, Dec. 1980; total-agriculture index is based on F.A.O. Production Yearbook and F.A.O. Yearbook of Food and Agricultureal Statistics, various issues, with adjustment for 1959, 68 and 69 figures.

TABLE A-8

HARVESTED AREA OF MAJOR FOOD CROPS
IN INDONESIA, 1950-1979

Year	Rice	Maize	Cassava	Sweet potato	Soy-beans	Peanut
			thousand hectares			
1950	5,699	2,031	826	222	355	274
1951	5,815	1,798	866	210	404	304
1952	6,114	2,232	927	335	417	278
1953	6,387	1,969	1,042	325	457	282
1954	6,610	2,518	1,071	285	525	324
1955	6,570	2,042	1,077	279	515	298
1956	6,700	2,232	1,125	384	502	317
1957	6,800	2,087	1,121	404	525	341
1958	6,900	2,702	1,341	449	594	231
1959	7,150	2,290	1,456	394	612	364
1960	7,280	2,640	1,417	393	651	377
1961	6,858	2,464	1,478	366	625	365
1962	7,283	3,175	1,449	544	594	371
1963	6,727	2,559	1,598	484	539	352
1964	6,980	3,646	1,579	620	571	373
1965	7,348	2,537	1,754	416	584	351
1966	7,668	3,186	1,514	402	605	388
1967	7,516	2,547	1,524	360	589	351
1968	8,013	3,220	1,503	404	677	394
1969	8,014	2,435	1,467	369	553	372
1970	8,186	3,018	1,398	359	695	380
1971	8,222	2,627	1,382	347	666	375
1972	7,983	2,160	1,418	318	685	356
1973	8,404	3,433	1,450	325	751	407
1974	8,508	2,648	1,513	333	753	409
1975	8,495	2,445	1,410	311	752	475
1976	8,369	2,095	1,353	301	646	414
1977	8,360	2,557	1,364	326	646	506
1978	8,829	3,025	1,383	301	733	514
1979	8,850	2,600	1,398	309	710	517

Source: Statistical Pocketbook of Indonesia, various issues.

TABLE A-9

PRODUCTION OF MAJOR FOOD CROPS
IN INDONESIA, 1950-1979

Year	Rice[a]	Maize[b]	Cassava[c]	Sweet potato[c]	Soy-bean[d]	Peanut[e]
			thousand tons			
1950	9,985	1,571	5,783	1,422	204	283
1951	9,284	1,600	7,134	1,303	276	268
1952	9,910	1,637	7,535	2,291	286	286
1953	10,910	1,815	8,953	2,176	306	336
1954	11,701	2,721	9,560	2,110	400	406
1955	11,257	1,971	9,317	1,898	346	339
1956	11,403	1,965	9.131	2,638	357	364
1957	11,448	1,860	10,118	2,653	339	387
1958	11,969	2,634	10,972	2,813	418	387
1959	12,441	2,041	12,697	2,877	431	425
1960	13,151	2,460	11,377	2,709	443	378
1961	12,402	2,283	11,190	2,464	426	420
1962	13,347	3,243	11,386	3,680	397	435
1963	11,900	2,358	11,679	3,070	350	392
1964	12,630	3,769	12,262	3,958	392	435
1965	13,600	2,283	12,643	2,651	410	405
1966	14,056	2,874	11,232	2,476	417	432
1967	13,222	2,369	10,747	2,144	416	402
1968	14,858	3,166	11,356	2,364	420	478
1969	15,553	2,293	11,034	2,260	389	445
1970	17,529	2,888	10.478	2,175	498	468
1971	18,663	2,606	10,042	2,154	516	473
1972	18,031	2,254	10,385	2,066	518	470
1973	21,500	3,690	11,185	2,387	529	505
1974	22,473	3,011	13,031	2,470	586	512
1975	22,330	2,903	12,546	2,433	590	630
1976	23,301	2,572	12,191	2,381	522	570
1977	23,356	3,143	12,488	2,460	523	681
1978	25,781	4,029	12,902	2,083	616	733
1979	26,350	3,200	13,100	2,350	575	739

Source: Statistical Pocketbook of Indonesia, various issues.

[a] dry paddy.
[b] shelled corn.
[c] fresh roots.
[d] green soybeans.
[e] in shell.

TABLE A-10

PLANTED AREAS OF MAJOR COMMERCIAL CROPS
IN INDONESIA, 1950-1979

Year	Rubber	Coconut	Coffee	Tea	Tobacco	Oil palm
			thousand hectares			
1950	1,480	1,020	152	143	.	83
1951	1,506	1,041	148	147	131	90
1952	1,724	1,237	164	147	171	94
1953	1,771	1,284	169	142	125	96
1954	1,986	1,496	182	143	158	100
1955	1,921	1,514	197	145	134	101
1956	2,008	1,545	211	137	178	103
1957	2,065	1,597	239	135	192	103
1958	1,991	1,651	246	134	186	104
1959	1,993	1,561	256	136	145	103
1960	1,936	1,649	278	137	142	104
1961	1,960	1,666	287	137	201	105
1962	2,084	1,637	272	136	177	105
1963	2,082	1,608	310	137	102	106
1964	2,106	1,578	290	131	112	108
1965	2,116	1,557	306	129	144	104
1966	2,103	1,496	319	134	126	108
1967	2,072	1,491	328	126	114	106
1968	2,200	1,610	338	120	134	120
1969	2,257	1,685	377	111	186	121
1970	2,299	1,809	390	114	128	124
1971	2,328	1,855	393	118	127	139
1972	2,306	1,908	396	97	173	143
1973	2,312	2,006	379	95	175	156
1974	2,308	2,108	384	95	171	164
1975	2,293	2,211	390	95	194	171
1976	2,270	2,322	431	95	191	180
1977	2,352	2,404	493	103	148	182
1978	.	.	.	.	.	207
1979	.	.	.	.	.	229

Source: From Statistical Pocketbook of Indonesia, various issues, except 1955-1964 data of coconut and rubber, and 1951-1963 data of coffee which are from Zahri (1969:167) and Thomas & Panglaykim (1967:337-70), respectively.

TABLE A-11

PRODUCTION OF MAJOR COMMERCIAL CROPS
IN INDONESIA, 1950-1979

Year	Rubber[a]	Coconut[b]	Coffee[c]	Tea[d]	Tobacco[e]	Oil palm[f]
			thousand tons			
1950	767	616	47.3	58.5	58.7	126.5
1951	864	740	51.1	60.4	55.6	121.1
1952	782	1,135	50.1	75.5	72.8	146.4
1953	682	966	62.0	70.1	57.0	160.5
1954	805	1,221	57.7	68.3	66.4	168.7
1955	723	1,055	63.3	65.7	50.3	165.8
1956	697	1,100	60.0	64.9	60.9	164.9
1957	698	1,113	75.3	69.9	77.0	160.2
1958	680	1,085	66.7	72.2	66.7	147.7
1959	707	1,107	84.3	76.4	59.2	137.5
1960	640	1,239	95.9	79.2	58.7	141.2
1961	717	1,360	97.4	81.4	85.4	145.7
1962	656	1,378	103.2	84.0	72.0	141.5
1963	617	1,379	129.9	77.0	82.0	148.3
1964	706	1,193	123.6	65.9	45.2	164.0
1965	724	1,214	140.5	79.8	60.3	156.6
1966	737	1,138	142.2	77.0	52.7	165.7
1967	699	1,101	159.8	76.0	46.3	167.7
1968	739	1,139	157.6	76.1	54.2	181.4
1969	782	1,173	175.5	71.9	71.9	188.7
1970	809	1,207	186.3	64.6	59.5	216.5
1971	810	1,139	197.0	72.4	62.6	248.4
1972	804	1,259	180.5	60.2	124.4	269.4
1973	844	1,287	150.4	67.4	75.6	290.0
1974	822	1,444	159.1	64.4	78.7	351.1
1975	787	1,391	170.7	69.4	93.1	411.4
1976	786	1,537	185.3	73.0	82.8	433.9
1977	847	1,583	208.5	86.7	81.0	497.4
1978	.	.	.	.	.	525.0
1979	.	.	.	.	.	559.9

Source: Statistical Pocketbook of Indonesia, various issues, except 1955-64 data for coconut and rubber, and 1951-63 data for coffee which are from Zahri (1969:167) and Thomas & Panglaykim (1967:337-70), respectively.

[a] dry rubber.
[b] copra equivalent.
[c] dry coffee beans.
[d] green leaves.
[e] dry leaves.
[f] palm oil.

TABLE A-12

NUMBER OF LIVESTOCK SLAUGHTERED BY KIND OF ANIMALS IN INDONESIA, 1950-1978

Year	Kind of livestock		
	Cattle	Buffalo	Goat/sheep
	thousand head		
1950	557	260	723
1951	575	295	832
1952	731	272	906
1953	606	304	1,017
1954	585	302	1,052
1955	644	318	1,092
1956	694	250	1,090
1957	767	246	1,014
1958	677	255	1,034
1959	657	264	1,004
1960	682	265	1,096
1961	800	252	1,147
1962	768	222	1,153
1963	744	205	1,211
1964	772	247	1,244
1965	789	249	1,266
1966	843	324	1,341
1967	816	95	352
1968	653	155	283
1969	808	201	382
1970	864	191	943
1971	697	193	683
1972	778	203	806
1973	729	205	878
1974	729	211	817
1975	752	214	890
1976	809	223	1,153
1977	840	217	994
1978	828	211	1,062

Source: The 1950-64 data are from Higgins (1957:169), and others are from Statistical Pocketbook of Indonesia, various issues.

TABLE A-13

NOMINAL VALUE ADDED FROM AGRICULTURAL SECTOR IN INDONESIA, 1950-1979

Year	Total agriculture	Crops & livestock	Food crops
		billion rupiahs[a]	
1950	20.2	18.4	12.88
1951	39.2	35.9	24.73
1952	46.0	42.2	29.06
1953	48.8	45.6	32.21
1954	56.1	48.1	37.25
1955	72.4	67.5	47.79
1956	81.6	76.5	54.90
1957	93.5	78.9	62.28
1958	124.0	110.4	80.00
1959	173.0	152.4	105.80
1960	214.0	191.3	134.00
1961	303.0	266.3	196.70
1962	890.0	727.2	571.70
1963	1,892.0	1,622.1	1,210.40
1964	3,793.0	3,345.9	2,710.80
1965	14,164.0	12,332.2	8,481.40
1966	168.4	141.6	106.80
1967	457.3	398.5	300.70
1968	1,069.3	937.2	689.50
1969	1,339.0	1,179.0	822.70
1970	1,575.0	1,361.0	962.20
1971	1,646.0	1,388.0	961.70
1972	1,837.0	1,550.0	1,071.00
1973	2,710.0	2,221.0	1,573.00
1974	3,497.0	2,996.0	2,096.00
1975	4,003.4	3,399.4	2,554.80
1976	4,812.0	4,084.0	3,043.90
1977	5,905.7	5,042.5	3,659.50
1978	6,706.0	5,659.4	3,991.40
1979	9,145.0	7,652.5	5,365.30

Source: The figures of 1951-1952 are from Higgins (1957:177); 1953-1957 are from U.N. Economic Survey of Asia & Far East, 1961; 1958-1967 are from Pendapatan Nasional (National Income) Report, 1960 and 1968; 1968-1979 data are from Statistical Pocketbook of Indonesia, various issues; and 1950 data are based on the series of production index from F.A.O. Yearbook of Food and Agricultural Statistics, various issues, and price index from U.N. Statistical Yearbook, various issues.

[a]From 1966 to the present, the new rupiah was used which is equivalent to 1,000 old rupiahs.

TABLE A-14

REAL VALUE ADDED FROM AGRICULTURAL SECTOR IN INDONESIA, 1950-1979

Year	Total agriculture[a]	Crops & livestock[b]	Food crops[b]
	billion rupiahs at 1960 prices		
1950	149.3	142.7	94.6
1951	158.7	151.1	100.2
1952	162.0	152.8	102.5
1953	173.7	161.9	110.5
1954	189.7	177.8	121.9
1955	189.4	170.3	116.2
1956	191.9	172.0	118.5
1957	198.1	176.1	120.8
1958	205.0	181.1	124.3
1959	212.0	187.4	127.9
1960	214.0	188.7	132.0
1961	214.0	186.6	129.6
1962	227.0	198.6	140.1
1963	217.0	195.7	130.2
1964	227.0	207.1	140.1
1965	232.0	209.1	142.3
1966	239.0	219.7	151.0
1967	236.0	215.1	146.8
1968	248.0	230.0	160.2
1969	260.0	240.0	170.2
1970	271.0	248.0	175.7
1971	281.0	255.0	181.5
1972	287.0	261.0	184.0
1973	312.0	272.8	197.0
1974	323.6	293.7	212.7
1975	323.6	299.4	214.6
1976	338.9	310.8	224.7
1977	343.2	317.4	219.4
1978	360.9	327.4	232.3
1979	368.8	333.1	235.5

[a]The 1951-1957 data are from Mangkusuwondo (1974:13), 1958-1968 data from U.N. Yearbook of National Account Statistics, various issues, and 1969-1979 data are from Statistical Pocketbook of Indonesia, various issues. The 1950 figure is based on output index from F.A.O. Yearbook of Food and Agriculture Statistics, various issues.

[b]The 1958-1968 data are from Pendapatan Nasional (National Income) Report, 1960 and 1968, and 1969-1979 figures from Statistical Pocketbook of Indonesia, various issues. Figures of 1950-1957 are based on production index and aggregate price index linked to the 1958-1979 value added figures.

TABLE A-15

AGGREGATE PRICE INDEXES OF AGRICULTURAL OUTPUTS, INDONESIA, 1950-1979

Year	Total agriculture[a]	Crops & livestock[b]	Food Crops[c]
		1960=100	
1950	13.53	13.54	11.2
1951	22.50	22.67	21.1
1952	21.25	21.33	22.3
1953	22.39	22.43	23.7
1954	24.21	24.24	25.1
1955	32.67	32.94	33.4
1956	34.98	35.20	38.2
1957	39.03	39.58	41.9
1958	58.04	59.63	61.1
1959	78.26	79.75	75.8
1960	100.00	100.00	100.0
1961	113.72	113.59	119.2
1962	274.78	278.52	291.7
1963	671.44	674.98	717.1
1964	1,386.86	1,423.45	1,538.6
1965	5,962.35	6,120.99	6,497.4
1966	67.48	68.62	75.2
1967	154.69	153.76	162.7
1968	384.95	389.56	411.4
1969	398.54	396.03	370.3
1970	452.70	454.43	441.8
1971	470.07	467.98	436.0
1972	550.35	554.78	556.3
1973	783.83	856.82	838.9
1974	976.59	978.89	870.7
1975	1,085.81	1,088.47	1,078.6
1976	1,338.77	1,355.23	1,320.9
1977	1,564.78	1,587.50	1,461.6
1978	1,730.89	1,766.96	1,657.6
1979	2,049.92	2,092.75	1,924.4

[a]Price index of fish was added to price index of crops and livestock to estimate the total agricultural price index. All weights were based on the share of the value of production.

[b]Weighted sum of food-crop price index, price indexes of four major commercial crops, and price index of meat.

[c]1950-1961 data were from Statistik Kunjunktur, various issues, 1962-1977 were from Statistical Pocketbook of Indonesia, various issues, and 1978-1979 were estimated based on the series of prices of six major food crops.

TABLE A-16

PRICE INDEXES OF THE MAIN PURCHASED INPUTS IN INDONESIA, 1950-1979

Year	Fertilizer[a]	Farm Chemicals[a]	Seed[b]	Feed[c]
		1960=100		
1950	30.7	17.8	13.12	11.05
1951	27.5	19.3	29.65	33.20
1952	43.0	29.1	34.44	35.31
1953	43.3	32.1	28.80	24.07
1954	46.7	33.4	29.85	24.38
1955	57.2	34.5	36.94	40.18
1956	71.5	44.1	44.96	49.59
1957	91.0	53.1	55.07	49.18
1958	89.6	49.0	93.16	72.09
1959	88.4	77.1	91.80	82.52
1960	100.0	100.0	100.00	100.00
1961	176.1	134.4	167.57	152.85
1962	296.7	239.0	555.43	460.88
1963	303.5	106.4	1,027.03	1,116.76
1964	1,692.0	532.0	2,519.07	2,195.80
1965	1,842.2	4,362.6	9,459.86	9,335.10
1966	146.1	23.3	83.11	71.57
1967	442.8	172.6	250.85	218.07
1968	502.9	342.1	584.12	495.22
1969	599.0	338.4	493.68	604.25
1970	540.1	391.7	588.90	669.08
1971	550.6	342.8	561.22	650.90
1972	649.2	335.8	664.60	822.19
1973	910.2	243.0	1,010.82	1,170.75
1974	2,066.3	445.6	1,021.39	1,437.40
1975	3,808.2	544.1	1,332.03	1,774.95
1976	2,250.0	593.4	1,634.14	2,181.48
1977	1,852.9	696.4	1,703.83	1,968.63
1978	1,701.5	713.5	2,062.50	2,142.71
1979	2,048.2	1,010.3	2,412.89	2,474.27

[a]Indexes were based on reported amount and value of imports from Statistik Kunjunktur, 1955 to 1962 issues, and Statistical Pocketbook of Indonesia, 1963 to 1979/80 issues. Official exchange rates were used with adjustment made for the years in between devaluations.

[b]Indexes were based on prices of rice, corn and soybeans.

[c]Based on price of rice bran, broken corn, and soybeans wastes with 6:2:1 combination.

TABLE A-17

PRICE INDEXES OF AGGREGATED FARM IMPUTS IN INDONESIA, 1950-1979

Year	Fertilizer chemicals	Seed/feed	Purchased inputs: crops/ livestock	Purchased inputs: food crops
		1960=100		
1950	29.0	12.30	23.8	25.6
1951	26.4	31.05	27.9	27.1
1952	41.2	34.78	39.2	39.7
1953	41.8	26.94	37.2	39.0
1954	45.0	27.69	39.5	41.7
1955	54.2	38.22	49.2	50.5
1956	67.9	46.78	61.3	62.9
1957	86.1	52.75	75.6	79.3
1958	84.3	84.86	84.5	86.2
1959	86.9	88.14	87.3	88.0
1960	100.0	100.00	100.0	100.0
1961	170.7	161.77	167.9	170.0
1962	289.2	518.17	361.2	347.1
1963	277.8	1,062.39	524.7	440.8
1964	1,540.7	2,391.67	1,808.6	1,753.7
1965	16,432.3	9,410.69	14,223.5	14,915.4
1966	130.1	78.56	113.9	119.9
1967	407.6	237.93	354.2	373.5
1968	481.9	549.08	503.1	504.2
1969	565.0	537.26	556.3	549.5
1970	520.7	620.50	552.1	535.6
1971	523.5	596.56	546.5	531.7
1972	608.3	726.71	645.6	620.6
1973	823.2	1,073.85	902.1	864.0
1974	1,855.0	1,185.34	1,644.3	1,673.6
1975	3,382.6	1,506.58	2,792.4	2,936.4
1976	2,034.0	1,849.85	1,976.1	1,947.0
1977	1,702.1	1,808.19	1,735.5	1,702.5
1978	1,572.7	2,094.11	1,736.8	1,679.3
1979	1,912.9	2,437.08	2,077.9	2,021.7

Source: Weighted sum of price indexes of the respective input components (see Table A-16). Weights were based on their share of generated gross return from agricultural census data, 1978/1979. Inputs for the food crops were from Statistical Pocketbook of Indonesia, 1979/80.

TABLE A-18

INDEX OF AGGREGATE PRODUCTION PER UNIT OF LAND, LABOR AND FIXED CAPITAL IN INDONESIAN AGRICULTURE, 1950-1979

Year	Agricultural output per unit of		
	land[a]	labor[b]	fixed capital[c]
	1960=100		
1950	71.804	72.967	85.578
1951	85.761	86.331	98.423
1952	88.948	91.120	105.030
1953	93.014	94.344	102.909
1954	97.151	101.826	107.674
1955	92.634	96.408	99.233
1956	92.232	95.554	96.864
1957	93.104	97.547	99.158
1958	95.761	99.536	98.465
1959	98.686	99.828	98.479
1960	100.000	100.000	100.000
1961	96.795	98.536	90.432
1962	104.330	106.409	93.556
1963	104.118	99.231	89.126
1964	102.454	105.292	91.709
1965	103.750	105.855	90.745
1966	104.848	107.118	90.444
1967	105.094	105.810	89.808
1968	106.742	109.886	93.187
1969	110.783	113.918	98.023
1970	121.801	125.989	108.955
1971	124.736	128.497	110.716
1972	128.199	131.003	112.392
1973	131.235	135.831	126.186
1974	133.894	138.273	123.760
1975	133.916	138.236	127.793
1976	126.295	135.610	122.801
1977	131.035	141.815	127.028
1978	139.544	151.152	130.540
1979	.	152.207	.

[a]Based on Table A-1 and Table A-7.

[b]Based on Table A-2 and Table A-7.

[c]Based on Table A-3, A-4, A-5, A-6 and A-7 (for the definition of capital see the footnote of Table 11).

TABLE A-19

REAL VALUE ADDED PER UNIT OF FACTOR OF PRODUCTION IN INDONESIA, 1950-1978

Year	Agricultural value added per			
	Agric. land[a]	Arable land[a]	Labor[b]	Fixed capital[c]
	billion rupiahs at 1960 prices			
1950	10.1496	12.8929	6.4632	2.19111
1951	10.7375	13.6693	6.7734	2.23210
1952	10.6299	13.9655	6.8239	2.27359
1953	11.3678	15.0650	7.2255	2.27815
1954	11.8711	16.1447	7.7970	2.38317
1955	11.8006	15.9831	7.6961	2.28976
1956	11.9045	16.2765	7.7286	2.26460
1957	12.0499	16.5635	7.9113	2.32457
1958	12.4696	17.1261	8.1220	2.32245
1959	13.1514	18.0579	8.3366	2.37716
1960	13.2262	18.2283	8.2881	2.39572
1961	12.9776	17.8482	8.2785	2.19616
1962	13.7077	18.9482	8.7611	2.22654
1963	13.9640	19.8174	8.3397	2.16515
1964	13.4638	18.4553	8.6707	2.18299
1965	13.7604	18.8618	8.7979	2.18006
1966	13.9766	18.9683	8.9480	2.18385
1967	13.8335	18.7302	8.7278	2.14127
1968	14.0510	19.2248	9.0643	2.22192
1969	14.5822	20.1550	9.3965	2.33710
1970	14.9476	20.8462	9.6890	2.42198
1971	15.4142	21.6154	9.9504	2.47822
1972	15.7260	22.0769	10.0702	2.49730
1973	16.7203	23.4586	10.8446	2.91210
1974	17.2311	24.3308	11.1509	2.88491
1975	17.0855	24.2397	11.0519	2.95326
1976	17.0216	23.9167	11.4532	2.99789
1977	16.9985	24.1690	11.5284	2.98487
1978	17.7172	25.2908	12.0260	3.00215

[a]A unit of land was a million hectares.

[b]A unit of labor was a million man years.

[c]A unit of fixed capital was a billion of 1960 rupiahs.

TABLE A-20

INDEXES OF AGRICULTURAL LAND PER WORKER, PRODUCTION PER WORKER, AND VALUE ADDED PER WORKER IN INDONESIA, 1950-1979

Year	Land per worker[a]	Production per worker[b]	Value added per worker[c]
		1960=100	
1950	101.620	72.967	77.981
1951	100.665	86.331	81.724
1952	102.443	91.120	82.334
1953	101.430	94.344	87.178
1954	104.812	101.826	94.074
1955	104.074	96.408	92.856
1956	103.602	95.554	93.248
1957	104.772	97.547	95.454
1958	103.942	99.536	97.996
1959	101.157	99.828	100.585
1960	100.000	100.000	100.000
1961	101.798	98.536	99.884
1962	101.993	106.409	105.706
1963	95.306	99.231	100.622
1964	102.770	105.292	104.616
1965	102.029	105.855	106.150
1966	102.164	107.118	107.961
1967	100.682	105.810	105.305
1968	102.945	109.886	109.365
1969	102.830	113.918	113.372
1970	103.439	125.989	116.901
1971	103.015	128.497	120.056
1972	102.187	131.003	121.501
1973	103.502	135.831	130.845
1974	103.270	138.273	134.541
1975	103.225	138.236	133.346
1976	107.375	135.610	138.188
1977	112.515	141.815	139.095
1978	107.787	151.152	145.099
1979	.	152.207	.

[a]Based on Table A-1 and Table A-2.

[b]Based on Table A-18.

[c]Based on Table A-19.

APPENDIX B

REGRESSIONS OF INPUTS, OUTPUTS, AND PARTIAL PRODUCTIVITIES ON TIME

TABLE B-1

ESTIMATED COEFFICIENTS OF REGRESSIONS OF LAND, LABOR AND FIXED CAPITAL ON TIME, 1950-1978

Regressors	Dependent variables[a]					
	$\ell n Z_1$		$\ell n Z_2$		$\ell n Z_3$	
	Model A	Model B	Model A	Model B	Model A	Model B
Constant term	2.6850	2.6739	3.1418	3.1329	4.2964	4.1931
	(0.0098)	(0.0145)	(0.0024)	(0.0023)	(0.0223)	(0.0170)
T	0.0101	0.0154	0.0090	0.0111	0.0187	0.0335
	(0.0006)	(0.0022)	(0.0001)	(0.0004)	(0.0013)	(0.0030)
D_1		0.0269		0.0475		0.0148
		(0.0388)		(0.0070)		(0.0524)
D_2		-0.0988		-0.0015		0.4371
		(0.0367)		(0.0066)		(0.0496)
$T*D_1$		-0.0080		-0.0053		-0.0045
		(0.0035)		(0.0006)		(0.0047)
$T*D_2$		0.0005		-0.0017		-0.0295
		(0.0027)		(0.0005)		(0.0036)
R^2	0.9208	0.9617	0.9935	0.9986	0.8843	0.9841

[a] Z_1 stands for agricultural land (million hectares, Table A-1), Z_2 for labor force in agriculture (million workers, Table A-2), and Z_3 for fixed capital (billion of 1960-rupiahs, based on Tables A-3, A-4, A-5, and A-6); T denotes time period; D_1 represents a dummy variable whose value is 1 for 1959-66 period and 0 otherwise; D_2 is a dummy variable whose value is 1 for 1967-78 period and 0 otherwise; ℓn symbolizes natural logarithm. Estimated standard errors are in parentheses.

TABLE B-2

ESTIMATED COEFFICIENTS OF REGRESSIONS OF TOTAL-AGRICULTURE AND FOOD-CROP PRODUCTION ON TIME, 1950-1978

Regressors	Dependent variables[a]			
	ℓnY_a		ℓnY_f	
	Model A	Model B	Model A	Model B
Constant term	4.2962	4.2646	4.2210	4.1074
	(0.0230)	(0.0351)	(0.0251)	(0.0355)
T	0.0282	0.0399	0.0273	0.0517
	(0.0013)	(0.0062)	(0.0015)	(0.0063)
D_1		0.1509		0.3208
		(0.1078)		(0.1092)
D_2		-0.1951		-0.0874
		(0.1021)		(0.0949)
$T*D_1$		-0.0232		-0.0390
		(0.0097)		(0.0098)
$T*D_2$		-0.0019		-0.0166
		(0.0074)		(0.0073)
R^2	0.9425	0.9686	0.9283	0.9678

[a] Y_a stands for the index of total agriculture (1960=100) and Y_f for the index of food-crop production (1960=100). For other notations see the footnotes of Table B-1.

TABLE B-3

ESTIMATED COEFFICIENTS OF REGRESSION OF MAJOR FOOD CROP COMMODITIES ON TIME, 1950-1979

Regressors	Dependent variables[a]					
	ℓnY_1	ℓnY_2	ℓnY_3	ℓnY_4	ℓnY_5	ℓnY_6
Constant term	9.1519	7.3222	8.7207	7.2228	5.4284	5.5802
	(0.0364)	(0.1230)	(0.0489)	(0.0980)	(0.0689)	(0.0094)
T	0.0278	0.0494	0.0672	0.0835	0.0675	0.0474
	(0.0065)	(0.0219)	(0.0087)	(0.0174)	(0.0122)	(0.0094)
D_1	0.1602	0.0302	-0.6596	0.7515	0.7409	0.3735
	(0.1120)	(0.3782)	(0.1503)	(0.3013)	(0.2119)	(0.1630)
D_2	-0.5709	0.6285	0.1838	0.3848	0.0720	-0.4482
	(0.0973)	(0.3286)	(0.1306)	(0.2618)	(0.1842)	(0.1416)
$T*D_1$	-0.0163	-0.0113	-0.0676	-0.0825	-0.0794	-0.0419
	(0.0101)	(0.0341)	(0.0135)	(0.0271)	(0.0191)	(0.0147)
$T*D_2$	0.0269	-0.0251	-0.0483	-0.0782	-0.0369	0.0006
	(0.0075)	(0.0252)	(0.0100)	(0.0201)	(0.0141)	(0.0109)
R^2	0.9783	0.6333	0.8961	0.6899	0.8829	0.9318

[a] Y_1 stands for rice, Y_2 for maize, Y_3 for cassava, Y_4 for sweet potatoes, Y_5 for soybeans, and Y_6 for peanuts. All are in thousand tons (Table A-1). For other notations see the footnotes of Table B-1.

TABLE B-4

ESTIMATED COEFFICIENTS OF REGRESSIONS OF MAJOR COMMERCIAL CROPS ON TIME, 1950-1979

Regressors	Dependent variables[a]					
	ℓnY_7	ℓnY_8	ℓnY_9	ℓnY_{10}	ℓnY_{11}	ℓnY_{12}
Constant term	6.7169	6.5895	3.7644	4.0229	4.0193	4.8689
	(0.0404)	(0.0802)	(0.0675)	(0.0829)	(0.1410)	(0.0456)
T	-0.0216	0.0598	0.0583	0.0312	0.0211	0.0288
	(0.0072)	(0.0142)	(0.0120)	(0.0147)	(0.0251)	(0.0081)
D_1	-0.3135	0.5872	-0.0864	0.4272	0.5207	-0.2177
	(0.1243)	(0.2466)	(0.2077)	(0.2548)	(0.4336)	(0.1402)
D_2	-0.3129	-0.2611	0.9408	-0.1587	-0.6721	-1.8013
	(0.1177)	(0.2334)	(0.1966)	(0.2215)	(0.3768)	(0.1327)
$T*D_1$	0.0311	-0.0634	0.0192	-0.0387	-0.0504	-0.0023
	(0.0112)	(0.0222)	(0.0187)	(0.0229)	(0.0390)	(0.0126)
$T*D_2$	0.0333	-0.0236	-0.0378	-0.0130	-0.0189	0.0823
	(0.0086)	(0.0170)	(0.0143)	(0.0170)	(0.0289)	(0.0097)
R^2	0.6906	0.7551	0.9728	0.3615	0.1567	0.9822

[a] Y_7 stand for rubber, Y_8 for coconut, Y_9 for coffee, Y_{10} for tea, Y_{11} for tobacco and Y_{12} for oil palm. All are in thousand tons (Table A-11). For other notations see the footnotes of Table B-1.

TABLE B-5

ESTIMATED COEFFICIENTS OF REGRESSIONS OF THE NUMBER OF LIVESTOCK SLAUGHTERED ON TIME, BY KIND OF ANIMALS 1950-1978

Regressors	Dependent variables[a]		
	ℓnY_{13}	ℓnY_{14}	ℓnY_{15}
Constant term	6.3354	5.6856	6.6670
	(0.0580)	(0.1059)	(0.1319)
T	0.0267	-0.0124	0.0411
	(0.0103)	(0.0188)	(0.0234)
D_1	-0.0845	-0.3162	-0.0834
	(0.1783)	(0.3257)	(0.4056)
D_2	0.1657	-1.5426	-2.6165
	(0.1688)	(0.3083)	(0.3839)
$T*D_1$	0.0011	0.0241	-0.0049
	(0.0161)	(0.0293)	(0.0365)
$T*D_2$	-0.0204	0.0592	0.0660
	(0.0123)	(0.0224)	(0.0279)
R^2	0.6452	0.7037	0.8030

[a] Y_{13} stands for cattle, Y_{14} for buffaloes, Y_{15} for goats/sheep (in thousand head, see Table A-12). For other notations see the footnotes of Table B-1.

TABLE B-6

ESTIMATED COEFFICIENTS OF REGRESSIONS OF DOUBLE PRICE DEFLATED VALUE ADDED (DVA) OF AGRICULTURE ON TIME, 1950-1978

Regressors	Dependent variable: $\ell nDVA$[a]	
	Model A	Model B
Constant term	5.0319	4.9900
	(0.0147)	(0.0162)
T	0.0282	0.0393
	(0.0009)	(0.0029)
D_1		0.1946
		(0.0498)
D_2		-0.1898
		(0.0471)
$T*D_1$		-0.0229
		(0.0045)
$T*D_2$		-0.0014
		(0.0034)
R^2	0.9757	0.9931

[a]DVA is in billion rupiahs at 1960 prices (Table A-14). For other notations see the footnotes of Table B-1.

TABLE B-7

ESTIMATED COEFFICIENTS OF REGRESSIONS OF PARTIAL PRODUCTIVITY OF LAND, LABOR, AND FIXED CAPITAL ON TIME, 1950-1978

Regressors	Dependent variables[a]					
	$\ln\psi_1$		$\ln\psi_2$		$\ln\psi_3$	
	Model A	Model B	Model A	Model B	Model A	Model B
Constant term	2.3469	2.3158	1.8901	1.8567	0.7355	0.7965
	(0.0111)	(0.0166)	(0.0131)	(0.0152)	(0.0308)	(0.0228)
T	0.0181	0.0239	0.0193	0.0282	0.0096	0.0059
	(0.0006)	(0.0030)	(0.0008)	(0.0027)	(0.0018)	(0.0040)
D_1		0.1677		0.1471		0.1871
		(0.0511)		(0.0466)		(0.0700)
D_2		-0.0910		-0.1883		-0.6269
		(0.0484)		(0.0441)		(0.0663)
$T*D_1$		-0.0149		-0.0177		-0.0191
		(0.0046)		(0.0042)		(0.0063)
$T*D_2$		-0.0009		0.0003		0.0281
		(0.0035)		(0.0032)		(0.0048)
R^2	0.9667	0.9825	0.9596	0.9873	0.5138	0.9376

[a] ψ_1, ψ_2 and ψ_3 stand for partial productivity of land, labor, and fixed capital, respectively, measured based on DVA per unit of primary inputs. For other notations see the footnotes of Table B-1.

APPENDIX C

ESTIMATION PROCEDURES

Appendix C-1

Estimation on Productivity Growth Rate

The growth rate of total productivity as defined by equation (26) can be computed in six steps. Computation for the 1950-78 period is presented as an example.

1. Regression of the logrithm of F gives

$$dF/F = 0.028243$$

2. Compute the geometric means of Z_j's and dZ_j's

$$Z_1 = 17.0621 \qquad dZ_1 = 0.172771$$
$$Z_2 = 26.4723 \qquad dZ_2 = 0.237086$$
$$Z_3 = 97.1755 \qquad dZ_3 = 1.814752$$

3. Compute ℓnZ_j's and ℓnR

$$\ell nZ_1 = 2.836859$$
$$\ell nZ_2 = 3.276100$$
$$\ell nZ_3 = 4.576519$$
$$\ell nR = 0.366611$$

4. Estimate G_{z_j}/G based on the SVA translog model (Table 18) and the values in step 2 and 3.

$$G_{z_1}/G = -0.081443$$
$$G_{z_2}/G = 0.144424$$
$$G_{z_3}/G = 0.001130$$

5. Compute $(G_z/G)'dZ$ from the values in step 4 and step 2

$$(G_z/G)'dZ = (-0.081443 \quad 0.144424 \quad 0.001130)\begin{bmatrix} 0.172771 \\ 0.237086 \\ 1.814754 \end{bmatrix}$$
$$= 0.02221986$$

6. Compute the productivity growth rate, $\overset{\sim}{\phi}$, insert step 1 and step 5

$$\overset{\sim}{\phi} = dF/F - (G_z/G)'dZ = 0.00602314$$
$$\simeq 0.60 \text{ percent.}$$

Appendix C-2

The Maximum Entropy (ME) Procedure

In estimating regression coefficients, the maximum entropy (ME) procedure can be broken down into the following steps:

1. Arrange the sample values in the form of order statistics.

$$x^1 < x^2 < \ldots\ldots\ldots < x^n$$

2. Compute the primary midpoints

$$\xi_1 = (x^i + x^{i+1})/2, \text{ where } x^0 = x^1 \text{ and } x^{n+1} = x^n$$

3. Compute the secondary midpoints

$$\bar{x}^i = (\xi_{i-1} + \xi_1)/2, \text{ where } \xi_0 = X^1 \text{ and } \xi_n = x^n$$

4. Rearrange the values back to the original order, and denote as

$$\bar{x}_1, \bar{x}_2, \ldots\ldots \bar{x}_k, \ldots\ldots \bar{x}_n$$

5. ME variance is defined as $E(X - \bar{x})^2$

$$= \frac{1}{n} \sum_{k=1}^{n} (\bar{x}_k - \bar{x})^2 - \frac{1}{4n} \sum_{i=1}^{n-1} (x^{i+1} - x^i) - \frac{1}{24n} \sum_{i=2}^{n-1} (x^{i+1} - x^{i-1})$$

6. ME covarience is

$$E[(X - \bar{x})(Y - \bar{y})] = \frac{1}{n} \sum_{k=1}^{n} [\bar{x}_k - \bar{x})(\bar{y}_k - \bar{y})$$

7. Construct variance-covariance matrix (moment matrix) of the regressors based on step 5 and step 6, denote as X'X.

8. Construct the vector of covariance (moment) between dependent variable and regressors, denoted as X'y.

9. Apply OLS formula $\hat{\beta} = (X'X)^{-1}X'y$.

Appendix C-3

Computation on Technical Change Bias

The technical change bias coefficient, as describe by equation (29), can be computed in ten steps. Here, figures for 1950-78 period are used.

1. Estimate dZ_j's (see Appendix C-1)
2. Compute Z_j's, ℓnZ_j's and ℓnR (see Appendix C-1)
3. Estimate G_{z_j}/G, for all j's (see Appendix C-1)
4. Compute $(G_{z_j}/G)Z_j$, for all j's, based on the values in step 2 and step 3:

   $(G_{z1}/G)Z_1 = -1.389587$

   $(G_{z2}/G)Z_2 = 3.823235$

   $(G_{z3}/G)Z_3 = 0.109808$

5. Using the regression coefficients from DVA translog model and the values in step 2, compute F_{z_j}'s:

   $F_{z1} = 5.57942$

   $F_{z2} = 18.6009$

   $F_{z3} = 0.434382$

6. Regress Z_j/F on time to attain $d(Z_j/F)/dT$

   $d(Z_1/F)/dT = -0.0012801$

   $d(Z_2/F)/dT = -0.0021382$

   $d(Z_3/F)/dT = -0.0041689$

7. Compute the means of Z_j/F, for all j's:

   $Z_1/F = 0.0711167$

   $Z_2/F = 0.110217$

   $Z_3/F = 0.408712$

8. By regressing the logarithms of Z_j's and R on time, one can obtain

$$(dZ_1/dT)Z_1 = 0.0102$$

$$(dZ_2/dT)Z_2 = 0.0090$$

$$(dZ_3/dT)Z_3 = 0.0178$$

$$(dR/dT)R = -0.0058$$

9. Compute dF_{z_j}/dT using the values in step 7, step 8, and the coefficients from the DVA translog model

$$dF_{z1}/dT = -0.070272$$

$$dF_{z2}/dT = 0.294558$$

$$dF_{z3}/dT = -0.0719867$$

10. Compute the technical change bias coefficient

$$A_j = [\frac{Z_j}{F}(\frac{dF_{z_j}}{dT}) + F_{z_j}\frac{d}{dT}(\frac{Z_j}{F})]\frac{G}{G_{z_j z_j}}$$

$$A_1 = [0.071167 * (-0.070272) + 5.57942 * -0.0012801](-1.389587)^{-1}$$

$$= 0.0087361$$

$$A_2 = [0.110217 * 0.294558 + 18.6009 * -0.0021272](3.823235)^{-1}$$

$$= -0.001911$$

$$A_3 = [0.408712 * (-00719867) + 0.434382 * -0.0042914](0.109808)^{-1}$$

$$= -0.283257.$$

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BIOGRAPHICAL SKETCH

Ismet Ahmad was born in Negara, South Kalimantan, Indonesia, on February 26, 1945. He completed elementary school in the same town in 1957 and junior high school in Barabai three years later. After graduating from the Agricultural Senior High School in Banjarbaru, he entered the University of Lambung Mangkurat in 1963 and obtained the Sarjana Muda's degree in agricultural sciences in 1966. He served as a student volunteer in the government's mass guidance program for rice farmers until late 1967.

In early 1968 he went to Bogor to attend the Bogor Agricultural University, under an affiliated program with Lambung Mangkurat, and received an Insinyur's degree in agricultural economics in 1970. He joined the University of Lambung Mangkurat and was appointed as the Associate Dean III (Student Affairs and Public Service) of the Faculty of Agriculture in 1971. While working for the University he helped the Directorate of Rural Community Development in 1971, and the Provincial Office of the Farm Extension Service in 1972.

His performance in the Workshop on Rural Social Sciences which was ended in February 1973 led to the receipt of a Ford Foundation scholarship to pursue a master's degree

at the University of the Philippines, Los Banos, in June 1974. After obtaining the degree he returned to the University of Lambung Mangkurat and was elected as Chairman of the Department of Agricultural Economics and the Head of the Institute for Research and Public Service of the Faculty of Agriculture. In late 1977 he was appointed as the Deputy Chairman I of the Regional Scientific Development Center (RSDC) of South Kalimantan.

In September 1978, the Agricultural Development Council awarded him a scholarship to pursue a Ph.D. degree with a major in food and resource economics and a special field in economic development at the University of Florida. Prior to this, he attended the Economic Institute's Summer Program at the University of Colorado from June to August 1978, also with the Council's support, and achieved the honor roll.

He is married to Fauthyda and blessed with one daughter, Dewisari.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Max R. Langham

Max R. Langham, Chairman
Professor of Food and Resource Economics

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Woodrow W. McPherson

Woodrow W. McPherson
Graduate Research Professor of Food and Resource Economics

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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This dissertation was submitted to the Graduate Faculty of the College of Agriculture and to the Graduate Council, and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

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